PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 52 **Issued April 30th, 1956**

	Page
Handford—Grasshopper population sampling	3
MacCarthy—Insect populations in Cariboo potato fields	8
Downes—Observations on the effect of drought in insect populations with especial reference to Heteroptera Homoptera and Lepidoptera	12
Hardy—Notes on the life histories of four species of moths (Lepidoptera: Phalaenidae) indigenous to Vancouver Island, British Columbia	16
Proverbs—Chemical control of *Lygus* spp. (Hemiptera: Miridae) in British Columbia peach orchards	22
Arnott—Some factors reducing carrot seed yields in British Columbia	27
Spencer—Some unusual records of beetles in Vancouver	31
Spencer—Some records of ectoparasites from flying squirrels	32
Downing, Morgan and Proverbs—List of insects and mites attacking tree fruits in the Interior of British Columbia	34
Ross and Evans—Annotated list of forest insects of British Columbia Part III—*Eupithecia* spp. (Geometridae)	36
Ross and Evans—Annotated list of forest insects of British Columbia Part IV—*Hydriomena* spp. (Geometridae)	38
Clark—An annotated list of the Coleoptera taken at or near Terrace, British Columbia. Part 3	39
Revised Constitution of the Entomological Society of British Columbia	43
Book review	26
Science Notes	11, 21, 30, 44, 45, 46
In memoriam, J. R. J. Llewellyn-Jones	47

PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY *of* BRITISH COLUMBIA

Volume 52 **Issued April 30th, 1956**

	Page
Handford—Grasshopper population sampling	3
MacCarthy—Insect populations in Cariboo potato fields	8
Downes—Observations on the effect of drought in insect populations with especial reference to Heteroptera Homoptera and Lepidoptera	12
Hardy—Notes on the life histories of four species of moths (Lepidoptera: Phalaenidae) indigenous to Vancouver Island, British Columbia	16
Proverbs—Chemical control of *Lygus* spp. (Hemiptera: Miridae) in British Columbia peach orchards	22
Arnott—Some factors reducing carrot seed yields in British Columbia	27
Spencer—Some unusual records of beetles in Vancouver	31
Spencer—Some records of ectoparasites from flying squirrels	32
Downing, Morgan and Proverbs—List of insects and mites attacking tree fruits in the Interior of British Columbia	34
Ross and Evans—Annotated list of forest insects of British Columbia Part III—*Eupithecia* spp. (Geometridae)	36
Ross and Evans—Annotated list of forest insects of British Columbia Part IV—*Hydriomena* spp. (Geometridae)	38
Clark—An annotated list of the Coleoptera taken at or near Terrace, British Columbia. Part 3	39
Revised Constitution of the Entomological Society of British Columbia	43
Book review	26
Science Notes	11, 21, 30, 44, 45, 46
In memoriam, J. R. J. Llewellyn-Jones	47

DIRECTORS OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA FOR 1955-56

Honorary President

HON. W. K. KIERNAN, *Minister of Agriculture*

President

R. H. HANDFORD, Kamloops, B.C.

Vice-President

M. D. PROVERBS, Summerland, B.C.

President-Elect

H. ANDISON, Victoria, B.C.

Secretary-Treasurer

C. L. NEILSON, Vernon, B.C.

Honorary Auditor

J. WALTERS, Vernon, B.C.

Editor

K. M. KING, Victoria, B.C.

Editorial Committee

K. M. KING H. R. MACCARTHY

J. MARSHALL

Directors

G. J. SPENCER, Vancouver, B.C. D. ROSS, Vernon, B.C.

J. MARSHALL, Summerland, B.C.

GRASSHOPPER POPULATION SAMPLING*†

R. H. HANDFORD‡

Further illustration of the sampling principles discussed by Graham and Stark (1954) may be taken from problems encountered and methods used in sampling grasshopper populations. Unfortunately, many of the available examples are *still* problems, and many of the methods in practical use have not been critically tested for suitability and adequacy. The author has drawn from his own experience and from published accounts only sufficient material to illustrate the principles involved and to provide a reasonably comprehensive description of methods.

Purposes of Sampling Different Stages

The annual grasshopper survey is one of the most extensive projects in Canada and the United States requiring the use of specific sampling methods and techniques; the maps prepared from the survey data have proved to be of immense practical value to officials responsible for conducting control campaigns.

The maps are based on the numbers of eggs found in soil units of one square foot each, classified in terms of damage that might be expected during the following spring and summer; their accuracy in this respect varies with weather and crop conditions. The egg stage is used, rather than the adult stage, not only because it is "more stationary" and lends itself to "standard statistical procedures" (Graham and Stark, 1954) but also because adults can, and sometimes do, migrate from one area to another after an estimate has been made of their numbers and before egg-laying has been completed. Moreover, the number of eggs laid under various combinations of conditions by a given number of females has not been accurately determined. However, estimates of adult grasshopper populations are made before surveys of egg deposits in order (1) to provide rough indications of the area that may be omitted from the egg survey and (2) to provide data that can be used where necessary to supplement data obtained from the egg survey. The latter use is particularly important when autumn rains make completion of egg surveys impossible. Estimates of nymphal populations are made in restricted, representative areas to indicate the accuracy of the preceding egg survey.

Estimates of egg and nymphal populations are also required in experiments on control by means of cultural practices; estimates of nymphal and adult populations are required in experiments on chemical and biological control; and estimates of populations of all three stages are used in studies of population dynamics and the effects of ecological factors.

Methods of Sampling Different Stages and Species

Melanoplus mexicanus mexicanus (Sauss.), being the most widespread, persistent and generally injurious species in North America, has been the one most commonly used in studies of sampling methods. Probably the fact that it is more uniformly distributed than the other pest species, and more amenable to statistical procedures, has also influenced workers in this field.

Eggs of *Melanoplus m. mexicanus*

In sampling for eggs of *M. m. mexicanus* in the prairies of Western Canada, it is standard practice to sift samples of soil through a six-mesh screen, watching for eggs and egg pods in the soil as they fall through the screen, and finally for those left on the screen itself. Five sample units of one square foot, or ten of one-half square foot each, are taken per field. The units are distributed, without selection, over a distance of about 100 yards, but not necessarily at random.

---

* Contribution No. 3254, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.

† Editor's Note: This paper, which was read at the Kelowna meeting of the Ent. Soc., B.C., March, 1954, as part of a symposium on population sampling methods, reached the Editor just too late for inclusion in Vol. 51 of the Proceedings with that of Graham and Stark (1954).—K.M.K.

‡ Officer-in-Charge, Entomology Laboratory, Kamloops, B.C.

Routes of travel are adjusted to average about one field in one and one-half townships. Most of the samples are taken in grain fields, but if roadsides are in suitable condition for oviposition by this species they are also sampled.

Davis and Wadley (1949) found that sparse populations of eggs of *M. m. mexicanus* in the Great Plains area of the United States came very close to the Poisson, or truly random, distribution; as populations increased in density the variance increased more rapidly than the mean, indicating a departure from the Poisson series in those categories. However, they went on to explain that analyzing the data "as if the fields had been taken at random . . . does not lead to serious mistakes . . . What inaccuracy there is will be on the conservative side."

Considering practical as well as theoretical aspects, Davis and Wadley decided that sample units within fields need not be taken according to a fixed pattern nor by a strictly random method, but they should extend well into the field and be free from personal choice; fields to be sampled should be selected by systematic (stratified) methods. Allowing an error of 0.125 of a pod per square foot, they found that five square feet in each of ten fields would be sufficient for a county, or group of similar counties, containing uniform populations in the lower categories. Denser and/or less uniform populations could be brought within the limits of accuracy more economically by increasing the number of fields rather than the number of sample units within fields; 30 fields was the maximum number per county or group of similar counties required for any of the conditions studied by Davis and Wadley.

On the basis of these conclusions, more than 30 fields in 3000 square miles would rarely be required in a practical survey of eggs of *M. m. mexicanus* over large areas of country; considerably fewer than 30 would have to be sampled under conditions more commonly encountered. This suggests that Canadian surveys of the same species at the rate of five square feet in each of five or six fields per 324 square miles (nine townships) should be highly accurate in the main, the accuracy increasing directly with the size of an infested area and inversely with the intensity of infestation.

Eggs of *Camnula pellucida*

The methods used to sample nymphal and adult populations of *M. m. mexicanus* differ greatly from those used to sample egg populations of that species, and the methods used to sample egg populations of *Camnula pellucida* (Scudd.) also differ from those used to sample egg populations of *M. m. mexicanus*. These differences serve as excellent illustrations of the truth of the statement that "the sampling of a particular insect population must be resolved about the distribution and life cycle of the insect involved" (Graham and Stark, 1954).

Egg deposits of *C. pellucida* tend to be concentrated in restricted areas of sod of relatively few species of grass. To obtain an accurate estimate of such a variable population by strictly random means is impractical in general surveys (King, 1939). An attempt is made, therefore, to estimate the size and number of egg beds in a given number of miles of roadside or pasture, doing just enough detailed sampling to obtain a reasonably accurate estimate of the classes, or categories, into which the egg beds fall. Unlike the oviposition sites of *M. m. mexicanus*, the sod in the favoured sites of *C. pellucida* is usually too tough to make soil sifting possible; it must be shaved with a sharpened trowel or lifted with a spade, placed in a screen, and teased apart by hand. Where populations fall into the same category over a considerable area it may be possible to make as few as three stops in two townships, but in irregular infestations, or those lying close to the boundaries of a category, an observer may be obliged to make up to six stops per township. It is doubtful whether the data obtained by these methods are amenable to standard statistical procedures; at best, considerable experience is required to interpret the

results satisfactorily in terms of requirements for control.

Nymphs and Adults

Nymphal and adult populations are sampled by various methods, depending upon the use that is to be made of the resulting data and the accuracy required. During the annual survey, where it is desired to know the population per unit area but where economy of time is a major consideration, observers attempt to count the numbers of grasshoppers that leap or fly from quadrats of one square yard, the size of the quadrat being estimated visually. This is more difficult in nymphal populations because nymphs are less easily seen than adults and are usually present in much larger numbers per quadrat. The number of quadrats per field is not usually specified; an observer is required only to satisfy himself that he has obtained a reasonably accurate measure of the mean for the field. He rarely takes fewer than 10 quadrats or more than 25. The number of fields per municipality (Canada) or county (United States) closely approximates the number sampled during the egg survey. In experiments on chemical control, where it is necessary to know relative population densities only, comparisons are sometimes based on the number of specimens collected in a given number of strokes of a sweepnet (Hinman and Cowan, 1947). Smith and Stewart (1946), studying grasshopper populations in relation to biological control, developed a cage method that proved highly satisfactory for sampling nymphs and adults. These methods are all being compared at present with a method involving the dilution of a population with radio-active specimens. The work is being done under the leadership of L. G. Putnam, Grasshopper Research Co-ordinator for Canada, Entomology Laboratory, Saskatoon, Sask., and F. T. Cowan, Officer-in-Charge, United States Department of Agriculture, Agricultural Research Service, Entomology Research Branch, Bozeman, Mont.; the results have not yet been published.

Effects of Undesirable Variables

The subjects "patterns of variability within a sampling universe" and the desirability of sometimes "sampling with respect to the known environmental variates" have been covered by Graham and Stark (1954). Where sampling is done to compare population levels under different sets of conditions (much sampling is done for this purpose), undesirable variables must be carefully noted, and removed if at all possible. For example, estimates of adult grasshopper populations in an adequate series of weedy grain fields might logically be compared with estimates in an adequate series of clean fields, providing one wishes to gain some information on the relative attractiveness of the two types of fields to the species concerned; but a comparison of the data would be of little value, probably quite misleading, if the estimates in the series of weedy fields were made on a clear, hot, dry, calm day by observer A and those in the clean fields on a cloudy, cold, wet, windy day by observer B. The example is obviously extreme, but most workers are guilty at times of overlooking or ignoring one or more variables that might seriously affect the reliability of their samples.

Vegetation

Examples of the effects of the variations in vegetation density are available in reports on experiments with poisoned baits: The mean percentage mortality in baited cages placed in relatively dense vegetation was 21.1 per cent lower than in an adjacent series in which the same crop had been artificially thinned; the difference necessary for significance at the five per cent level was only seven per cent (Handford, 1941). In two sets of experiments designed for other purposes, but differing in several factors including density of vegetation, the treatments in dense vegetation gave an average of 23.2 per cent mortality whereas those in sparse vegetation gave an average of 87.7 per cent (Handford and Putnam, 1942.) These are, of course, merely illustrations of

the effects of variations in density of vegetation; in practice every effort is made to find uniform stands of vegetation for experiments in which treatments are being compared.

Weather

York and Prescott (1951), after making direct comparisons of sweep-net and cage methods of collecting grasshoppers at different times of the day and under different conditions, concluded that "the sweep-net method of sampling shows great variation in the catch of grasshopper nymphs and many other insects due to time of day and meteorological conditions, thus making it of little value in population studies. Its use in evaluating control on field plots seems valid if the treated and comparable untreated plots are sampled within a short period of time.

"Sampling with a cage is at least as fast as with the net, but is more 'back breaking'. It shows less variation from meteorological conditions than the insect net, and as a consequence is probably more advantageous when the weather is unfavorable for sweeping."

Personnel

That important differences can occur in the results obtained by different workers under almost identical conditions may be illustrated by a third example: Methods used in comparing the effects of different grasshopper baits on nymphs, described by Hinman (1939), required that a number of nymphs be collected from each plot and held in cages for 72 hours before mortality was determined. It was frequently necessary to have the collections made by two or three men in order to keep within uniform time limits. Using Student's *t* test on differences between pairs (Goulden, 1929), Handford and Putnam (unpublished report for the year 1940, on file at the Entomology Laboratory, Kamloops, B.C.) found that mean mortality difference of 12 per cent, in collections made by different workers, were significant at the 2 per cent level. The obvious correction was to have the collectors work as a group, each making part of the collection from each plot.

Removing Effects of Undesirable Variables

Where it is impractical or impossible to eliminate undesirable variables, every effort should be made to design techniques that will remove their effects. The six-mesh screen, for example, samples eggs of *M. m. mexicanus* satisfactorily under most conditions. However, where soil is gravelly, or moist, or full of debris, better results are obtained by using a four-mesh screen either alone or nested in the six-mesh screen. If soil is too moist to be handled this way, a good quality plasterer's trowel, well sharpened on the edges, serves to cut away thin layers of soil and expose the eggs. Soil that is baked can be cracked by means of a wooden mallet or block; if eggs are present the lumps usually break along the course followed by the ovipositor, thus exposing the pod.

Bias Resulting from Personal Selection

That "personal selection" may easily "bias the estimation of the mean" (Graham and Stark, 1954) may be illustrated by work done on sampling grasshopper egg populations. The author, in sampling fields at Piapot, Sask., in 1943, obtained a mean of 1.03 pods of *M. m. mexicanus* and *M. packardii* Scudd. per square foot in non-selected, stratified sampling, and a mean of 2.5 pods per square foot for selected, stratified samples; the difference, analyzed by Student's *t* test on differences between pairs, was significant at the 1 per cent level. The only criterion for selection was that the area from which a sample was taken should have been subjected to the maximum effects of the sun's rays; each selected sampling point was limited to a distance of three paces from the corresponding non-selected sample.

The Experimental Area as a Sample

Experimental procedures, as such, do not commonly come to mind when one is discussing the sampling of insect populations. Nevertheless, a set of experimental plots is a sample of a particular universe and should be subject to the same standards and the same restrictions as any other type of sample. As a rule an area used for an experiment on control forms a very small sample as compared with those taken in ecological studies or for purposes of estimating present or future damage; yet if the design and procedures satisfy the mathematical requirements, and the data have been analyzed statistically, conclusions are likely to be drawn with considerable confidence. The possibility that the site and conditions may not be truly representative, or that undesirable variables may not have been removed, is sometimes overlooked. A great deal of thought should be given to the selection of a site for field experiments and to the possible need for duplicate sites in important minor habitats. Failure to remove undesirable variables can increase the error variance to such an extent that true differences, which would otherwise be statistically significant, are effectively masked. At the other end of the scale one should never forget the possibility that his data may have come from the one experiment in 20, or one in 100, in which analysis indicated differences between treatments when, in fact, further work might have reduced the differences to the point where they were not significant. These and several related points are more clearly and adequately covered by Beveridge (1951).

Sampling Problems Awaiting Solution

As will have been gathered from the foregoing remarks, few, if any, of the sampling problems encountered in grasshopper studies have been completely solved. Although estimates of egg populations have been subjected to formal mathematical tests, still too little is known about the "patterns of variability" of even the major pest species. Mr. L. G. Putnam is now giving this problem further attention. Work under his direction and that of Mr. F. T. Cowan, on methods of sampling nymphal populations, has already been mentioned. The statistical adequacy of methods in general use for sampling adult grasshopper populations is still to be determined. There are innumerable minor problems within these major fields. It is recognized, for instance, that relatively more adults of *M. bivittatus* than of *M. mexicanus* are picked up in a net from a mixed population of these species when one walks slowly than when one moves more rapidly. The same is probably true to a lesser degree in mixed populations of *C. pellucida* and *M. m. mexicanus*. However, the differences have not been critically measured and compared. It also appears that nothing at all is known about the relationship between the true proportions of parasitized and non-parasitized grasshoppers in a given infestation and the proportion picked up in a sweep-net, one of the standard tools for doing such sampling. The effect of weather conditions on the results obtained in sampling adult and nymphal populations requires further study. These and many other problems in sampling grasshopper populations await the attention of workers interested in this very important field.

References

Beveridge, W. I. B. The art of scientific investigation. Corrected 2nd impression. William Heinemann Ltd., London. 171 pp. 1951.

Davis, E. G., and F. M. Wadley. Grasshopper egg-pod distribution in the northern Great Plains and its relation to egg-survey methods. U.S. Dept. Agr. Circ. 816. 16 pp. 1949.

Goulden, C. H., Chairman. Statistical methods in agronomic research. Pl. Breed. Ser. Pub. 2 Canadian Seed Growers Association, Ottawa, Ontario. 28 pp. 1929.

Graham, K., and R. W. Stark. Insect Population sampling. Proc. Ent. Soc. B.C. 51:15-20. 1954.

Handford, R. H. Progress report on grasshopper bait investigations, Canadian prairies, 1941. Canada Dept. of Agr., Field Crop Ins. Investig. No. 311. 16 pp. (Mimeographed). 1941.

Handford, R. H., and L. G. Putman. Progress report on grasshopper bait investigations, Canadian prairies, 1942. Dom. Dept. of Agr. Field Crop Ins. Investig. No. 315. 16 pp. (Mimeographed). 1942.

Hinman, E. J. Method of conducting field tests of grasshopper baits. Proc. 18th Ann. Meet. N. Central States Ent.. St. Paul., Minn. pp. 35-36. (Mimeographed). 1939.

Hinman, E. J., and F. T. Cowan. New insecticides in grasshhopper control. U.S. Dept. Agr. Bur. Ent. and Pl. Quar. E-722. 21 pp. 1947.

King, K. M. Population studies of soil insects. Ecol. Monogr. 9:270-286. 1939.

Smith, R. W., and W. W. A. Stewart. A useful cage for sampling field populations of grasshoppers. 76th Ann. Rept. Ent. Soc. Ontario, 1945. pp. 32-35. 1946.

York, G. T., and H. W. Prescott. Determination of grasshopper control from insecticide treatments in field-plot tests. J. Econ. Ent. 44:427-428. 1951.

INSECT POPULATIONS IN CARIBOO POTATO FIELDS[1]

H. R. MACCARTHY[2]

Field Crop Insect Section, Entomology Laboratory, Kamloops, B.C.

From late June to early September of 1951, 1952, and 1953, insect populations were sampled regularly on 3 farms, 10 miles apart, near Soda Creek, B.C. The objective was to correlate the populations, particularly of leafhoppers, with the natural incidence of witches'-broom virus disease of potato. Little or no disease appeared, but the populations and their dynamics are of interest both in themselves and economically.

Comparative freedom from virus-carrying insect pests has led to the establishment of a thriving seed potato industry in the Cariboo district. The montane climate and swift growseason ensure that the greatest pest of all, *Myzus persicae* (Sulz.), the green peach aphid, is not often seen and seldom becomes numerous. Most of the growers have never had occasion to use insecticides, nor do they own the necessary equipment.

Since 1949 the western potato flea beetle, *Epitrix subcrinita* (Lec.), has become established in the area, moving northward to Quesnel in 1954. From occasional specimens taken at Soda Creek in 1950 (Prof. G. J. Spencer, University of British Columbia, personal communication), it has increased almost to outbreak proportions, at one site killing the vines and severely damaging the tubers in 1952. In the 3 seasons under review, 85 samples of insects were taken, totalling upwards of 84,000 specimens, of which 91 per cent were adults of *E. subcrinita.* Randomized subsamples of flea beetles, submitted to Dr. L. G. Gentner, Medford, Oreg., confirmed the identity of the species. Of the remaining 7,200 insects, representative samples only were determined.

During the period, recorded monthly temperatures showed very little variation from year to year or from the long-term average, although in 1951 precipitation was below normal.

Methods

An average of about 2.5 samples were taken per week, each of 100 strokes with a standard 15-inch net. The samples were stratified into 4 subsamples of 25 strokes, taken in each quarter of a field. The subsamples were put together in the killing bottle and the total catch, including immature forms, was counted into the broad, easily recognized categories shown in Figs. 1 and 2.

Exploratory plotting suggested that populations of the insects were similar for corresponding weeks in the 3 years. With this in mind, the 3-years' data in each insect category were grouped into weekly subtotals, divided by the number of samples and

1 Contribution No. 3326, Entomology Division, Science Service. Department of Agriculture, Ottawa, Canada.

2 Associate Entomologist.

AVERAGE NUMBER OF INSECTS PER 100 SWEEPS

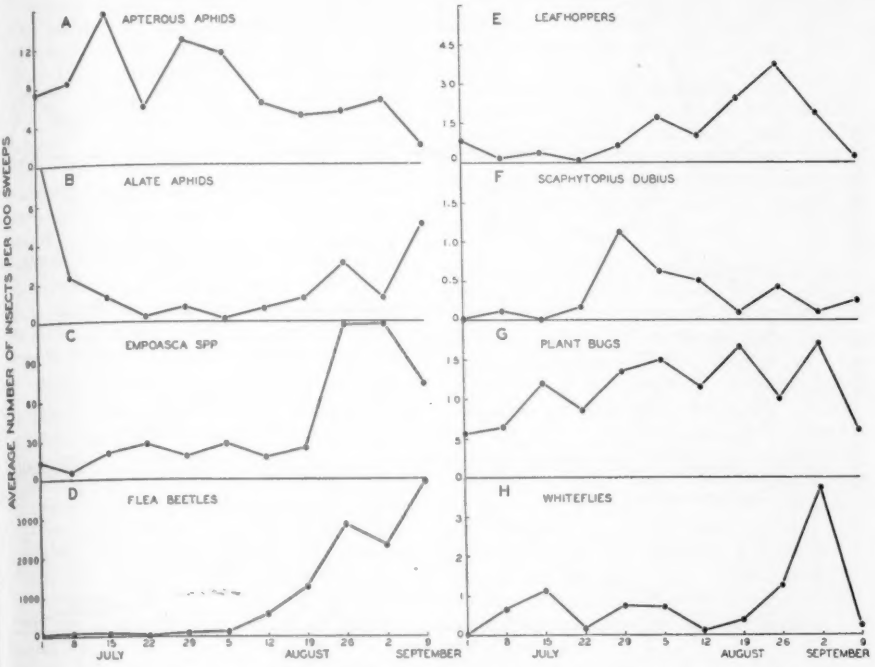

Fig. 1.—Populations of insects collected by sweeping in potato fields at Soda Creek, B.C., during 3 seasons, 1951-1953.

plotted on a common base-line with appropriate *y* axes. Since the sampling and treatment were uniform, the graphs give a fairly reliable picture of the simultaneous development of populations.

Results and Conclusions

Three groups, normally breeding on potatoes are potentially of major importance to growers. These are: aphids, *Empoasca* spp. of leafhoppers, and *E. subcrinita*. Seven groups, which may or may not breed on potatoes, are of minor importance. These are: leafhoppers other than *Empoasca* spp., plant bugs, whiteflies, psyllids, lacewings, ladybird beetles, and predatory Hemiptera. Four groups are incidental, or were during the years in question. These are: spittlebugs, treehoppers, grasshoppers, and caterpillars.

Examination of alate and apterous aphid samples in alcohol showed them to be overwhelmingly of the potato aphid, *Macrosiphum solanifolii* (Ashm.). The green peach aphid may well have been in the fields, failing to show up because the samples were perforce swept from the upper two-thirds of the vines, thus missing the preferred feeding site of *M. persicae* on the basal leaves, but including that of *M. solanifolii* on the growing tips. The typical hot-weather decline of the apterae (Fig 1, A), and the fall and rise of the alates are well illustrated (Fig. 1, B).

Empoasca spp. showed the high peak in late summer expected of prolific insects breeding within the crop (Fig. 1, C). Large, well-irrigated fields had the highest populations, but no crop was appreciably damaged by hopperburn.

Small, unirrigated fields had the highest populations of flea beetles. At these sites, the adults were at their

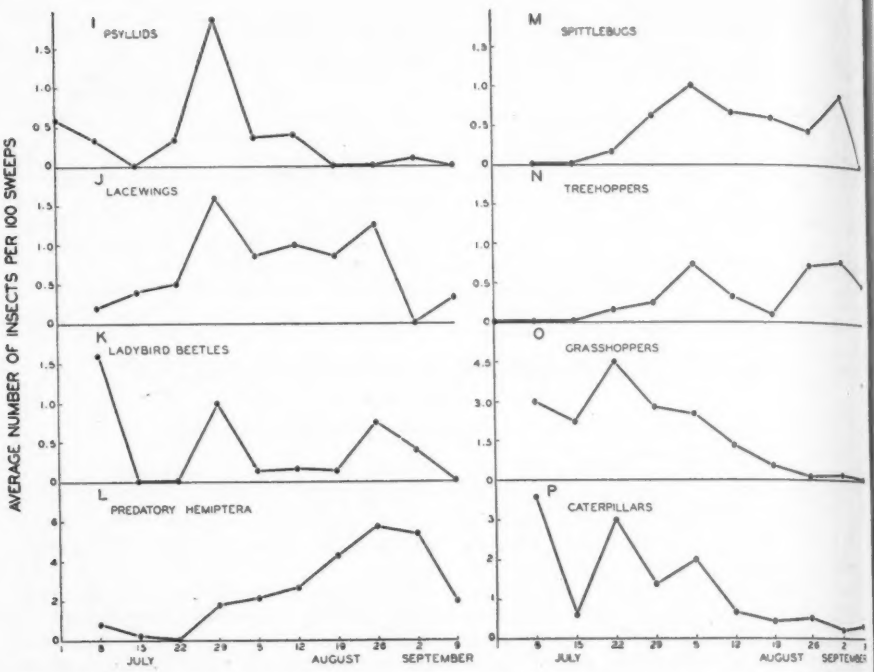

Fig. 2.—Populations of insects collected by sweeping in potato fields at Soda Creek, B.C., during 2 seasons, 1952-1953 (J-M, O, P) or 3 seasons, 1951-1953 (I, N).

peak in early September (Fig. 1, D), to be found not only in the remnant of the crop but also in the brush and on wild land surrounding the potato fields.

A number of leafhopper spceies other than *Empoasca* bred in the crops, producing a similar curve on a lower scale (Fig. 1, E). Determinations made so far indicate that about half of these fall into the genus *Macrosteles,* which includes known and suspected virus vectors. One species instantly recognizable is *Scaphytopius dubius* (Van Duzee), the sharp-nosed leafhopper (Fig. 1, F). This insect is a proved vector of witches'-broom virus disease of alfalfa (Menzies, J.D., 1946. Phytopathology *36*: 762-774), and is suspected of carrying others. It will breed on potato plants in cages, and will do so in the field, to judge by the nymphs sometimes caught well out from field borders.

The plant bugs, with overlapping generations breeding on a variety of plants and fairly strong fliers, show a uniform curve (Fig. 1, G). The number of bugs taken, particularly adults of *Lygus* spp., increased whenever any nearby hay crop was cut.

Most of the whitefly records were made during the dry season of 1951. Neither these nor psyllids constituted much of a threat to the crop (Figs. 1, H, and 2, I). Immature forms of these groups were not taken.

Numbers for the 3 groups of predators combined show a low negative correlation (−.311) with numbers of apterous aphids. The predatory Hemiptera were mostly species of *Geocoris* and *Nabis* (Fig 2, L.).

Treehoppers were most often taken in small fields with brushy borders, but spittlebugs occurred in larger fields, usually close to stands of alfalfa (Fig. 2, M and N).

Grasshoppers in all instars (Fig. 2, O) would be a potential threat to potatoes in the Cariboo were it not that they appear to feed on other plants more readily. Caterpillars Fig. 2, P) taken in 1952 and 1953 were usually of the bertha armyworm, *Mamestra configurata* Wlkr., a species that may approach damaging numbers in small areas, as in 1951. In that summer a disease, a polyhedrosis to judge by the symptoms, reduced the numbers to insignificance within a few days. Growers report this as occurring whenever the bertha armyworm becomes locally numerous.

The following list gives the insect groups other than flea beetles in order of average percentage of total numbers taken; *Empoasca* spp., 48.0; other leafhoppers, 15.4; plant bugs, 14.4; apterous aphids, 9.7; predatory Hemiptera, 2.4; grasshoppers, 2.2; caterpillars, 1.7; alate aphids, 1.2; whiteflies, 1.2; psyllids, 1.2; lacewings, 0.8; *Scaphytopius dubius*, 0.5; spittlebugs, 0.5; treehoppers, 0.4; ladybird beetles, 0.4. The order bears little relation to their importance to the crop, however, and the list is given as a record only.

Although the populations in fields fluctuated in concert, there was nonetheless a tendency for individual fields to have distinctive populations, influenced by size, surroundings, condition of the potato plants, and the presence of weeds.

The population graphs indicate that the most effective period for a single application of a general insecticide is probably the last week in July, when most of the groups were at or approaching a subpeak, as the first summer generations matured. Control measures in the week of July 15 would be equally effective, especially against aphids, but would probably need repeating about August 19. An application at this time would be especially useful against *E. subcrinita*, for it is larvae from eggs laid by adults emerging in mid August that have caused commercial damage.

Numbers of Collembola in a Swarm

At a previous meeting of this society I mentioned the way in which Collembola sometimes aggregate.

On 23 April, 1951, I was given a glass jar containing Collembola with the report that they were taken from a cabin on the North Shore Mountains of Vancouver, the day before. The owners of the cabin, going up for the week-end, had found the floor covered, as they said, by a layer of these insects one half inch deep. With a piece of paper, they scooped some into a glass jar and brought the jar down next morning. They were terrified of the carpet of insects and sat up in chairs all night for fear of being eaten alive if they dared to lie down on beds to sleep. The winter's snow lay deep on the ground and the Collembola must have moved up through it and invaded the cabin.

The insects were spread out on a large sheet of paper and air-dried under laboratory conditions. When thoroughly dry, they were weighed and counted. They were 56 c.c. in volume, and weighed 14.207 grams. Six samples of 100 at a time were weighed on a chain balance and averaged, and a total of 1,261,369 was reached for the entire mass. The insects were kindly identified for me by Mr. Lionel Wade of our University (who wrote a Master's thesis on the Collembola of the lower Fraser Valley), as *"Hypogastrura pseudarmata* (Folsom), family Poduridae, a mottled dark blue species extending from British Columbia to California".

What I take to be this species was sent in in quantity some years ago in early spring from a greenhouse near New Westminster and from Stanley Park Greenhouses; in both places the insects were reported to form so thick a layer on the floor that they gummed up the ordinary corn brooms and had to be shovelled out with a coal shovel.

It is of interest to speculate on the causes of such vast numbers of this insect suddenly appearing from apparently nowhere and as to their final disposition.—*G. J. Spencer. University of British Columbia.*

OBSERVATIONS ON THE EFFECT OF DROUGHT IN INSECT POPULATIONS WITH ESPECIAL REFERENCE TO HETEROPTERA HOMOPTERA AND LEPIDOPTERA

W. DOWNES

Victoria, B.C.

For many years entomologists have speculated on the causes of fluctuation in insect abundance, some of which are readily explained and others mysteriously obscure. Diseases, predators, parasites, destruction of host plants, storms and drought all play a part in regulating the number of insects. Some observations on the effect of drought on Vancouver Island form the subject of this paper.

The south-eastern part of Vancouver Island has an extremely light summer rainfall, similar to that of the interior dry belt south of Penticton. During the months of June, July and August the area around Victoria is probably the driest part of the Province, the total average rainfall for those months being 1.98 inches; this is a 65-year average. At Sidney the average for 37 years is 2.62 inches. Summer rains of any consequence are unusual and the country becomes dry and parched. This lack of summer moisture may account partly for the scarcity of diurnal lepidoptera on the island. Except for the ubiquitous cabbage butterfly and the small ringlet, *Coenonympha inornata insulana* McD., which is probably the most abundant butterfly on the island, few butterflies are seen during June, July and August. This scarcity of butterflies compared with the numbers which may be seen in the northern Okanagan Valley where summer rains frequently occur is very noticeable. The difference is not only in the number of species, but in the number of individuals of any species. In further comparison, although in Great Britain are found only 68 species of butterflies, some of them rare or occasional visitors, the abundance of butterflies is one of the features of the countryside and no doubt is due to the moist climate and high humidity which enable the food plants to remain lush and green.

Vancouver Island has 49 species of butterflies out of 155 species occurring in British Columbia. The proportionate number of moths is somewhat greater. The comparatively small number of species found on the island is not entirely due to climatic conditions but also to the nature of the country and its vegetation. Whereas the interior of the Province has large areas of open country interspersed with park-like spaces and low-lying ground, affording support for a long list of grasses and plants, Vancouver Island and the coast in general have no such terrain. Formerly several thousand acres of park-like land existed at the southern tip of Vancouver Island, much of which is now covered by the city of Victoria. There is a small area of a similar nature at Duncan and one at Comox and a few wide open patches on some of the islands in the gulf. Elsewhere the forest reaches to the water's edge, so that the area suitable for the growth of herbaceous plants is restricted. Of the 49 species of butterflies on Vancouver Island, 32 are herb or grass feeders, 13 are tree or shrub feeders and the hosts of four are unknown. Thus, drought conditions, by drying up the herbaceous plants and grasses, could well account for the small number of butterflies to be seen. This hypothesis becomes more probable in the light of what happened to insect life during the dry summer of 1951.

In that year the southern portion of Vancouver Island and the adjacent mainland were subject to the longest period of drought that had been recorded for fifty years. On Vancouver Island a continuous period of 95 days occurred, from May 25 to August 27, with not more than a

Average relative humidity and average temperature for 1951 compared with 1950 at Langford Forestry Station during June. July, and August.

	Average Relative Humidity per cent		Average Temperature degrees Fahr.	
	1950	**1951**	**1950**	**1951**
June	68.2	66.5	62.3	65.5
July	66.2	66.4	66.1	68.3
August	69.3	67.2	65.7	64.2

trace of rain. The drought could be said to have started earlier than that, however, since from May 13 to May 25 only .08 of an inch was recorded, an amount so small as to be negligible. Unfortunately it was not evident until the season was well advanced that a disastrous drought was upon us. Therefore no provision was made for anything resembling a quantitative survey or accurate recording of populations and the fragmentary data which I have been able to assemble result from observations made in the course of collecting trips at various times from May to September.

Through the courtesy of the Provincial Department of Forestry I was allowed to examine the meteorological records of the forestry stations. Those of the Langford Forestry Station, six miles inland, as summarized in the table, were selected as most typical of southern Vancouver Island. Such records are not necessarily representative of the places where insects were collected but reflect conditions in a general way. Relative humidity was unusually low, averaging during the three critical months about two per cent less than the previous year, while the average temperature was about two degrees higher. Moreover, during the hours from 8 p.m. to 4 a.m., the period during which humidity is highest, there was an unusual lag in the increase of relative humidity, the recordings in the first part of the period being exceptionally low. The prevalence of drying, northeast winds was a contributing cause. Also, inversion of humidity was observed. Whereas humidity should be higher on the lower levels and lower on the high levels; the reverse was often the case. These conditions were disastrous to vegetation and to the insects dependent on it. Arboreal species generally suffered less than those which feed on grasses and herbaceous plants but the number of species present on trees and bushes was generally much lower than normal. The effect of the drought conditions was to cause insects to concentrate on small patches of vegetation in shady places where a little moisture remained. Those species which inhabit swampy areas maintained their usual numbers along the banks of streams and estuaries but were killed-out where swamps had dried up. As the season advanced the moisture content of willows and other trees and shrubs, which normally support large numbers of insects, became too low and very few, even of common species, were found on them.

On the other hand, in valley bottoms and alluvial flats, alder trees and willows had the benefit of abundant moisture. Alder trees at the mouth of Goldstream creek were found to have an enormous population of a species of *Empoasca* and a fair number of *Psylla alni* Crawford. On the open grass flats at the mouth of the creek small leafhoppers concentrated on a few square feet of *Poa pratensis* which remained green. At a slightly lower level in a swamp grass and sedge association near tidewater, species of *Cicadula, Macrosteles* and *Sorhoanus* were found in their usual numbers and large numbers of tarnished plant bug nymphs were present with them.

On the river flats at Cowichan Bay a very large and luxuriant bush of *Salix scourleriana* growing close to the Cowichan river, where the water table could have been only a short distance below, was found to be swarming with a species of *Empoasca* and a considerable number of Nabidae and other insects. Less than twelve sweeps of the net secured 206 Homoptera. By contrast, the same species of willow growing at a higher level out of reach of the influence of

the water, yielded only 53 specimens of several species in about a hundred yards of sweeping. Thus, the survival of species and the extent of population was governed by the amount of moisture available. Insects were found to concentrate on any small oases formed by seepage from springs or on the banks of lakes or rivers with Homoptera predominating. Generally very few Heteroptera were found in proportion to Homoptera, except in some moist shaded spots where herbage remained green, Miridae being exceptionally scarce everywhere.

Having had long experience with the Heteroptera and Homoptera of this region I made an attempt to estimate the population of 64 species in terms of per cent of normal numbers. I found that of 42 grass and herb feeders, 30 species had decreased 70 to 95 percent, 8 species had decreased 30 to 50 per cent, and 4 species were in normal numbers. Of 16 tree and shrub feeders, 6 had decreased 70 to 95 per cent, 3 species had decreased 30 to 50 per cent, 5 species were in normal numbers, and two species of *Empoasca* showed an increase of 200 to 400 per cent. However, these estimates were made in localities favourable for insects. A properly organized quantitative survey over the entire district would have produced much lower averages. The two species of *Empoasca* on alder and willow, one of which was present in twice and the other in four times their usual numbers, were abundant only in exceptionally favourable spots and their numbers were probably augmented by migrants from trees on land where less moisture was available.

Predaceous species were similarly affected and the few that were obtained appeared to have decreased 50 to 80 percent. Several species of leafhoppers which are usually abundant seemed to have disappeared altogether. Of these *Aceratagallia sanguinolenta* Prov., a very small leafhopper which is usually abundant on grasses, was not found at all and had not reappeared three years later. However, the disappearance of this formerly very common species is linked with other causes, for it was found to be scarce in other parts of British Columbia not affected by drought in 1951. In three days of collecting at Kamloops by Mr. E. R. Buckell in 1954 only one specimen was obtained; collecting by myself at the same spot a few weeks later produced two, and one was taken at Spence's Bridge. None was found in the Fraser Valley or on Vancouver Island in 1954. The additional factor of drought at the coast appears to have reduced this species to such an extent that it may take many years to recover its numbers in that region. Others of the same group also were absent. Several species of small leafhoppers which feed on grasses were reduced to negligible numbers but were locally abundant the following year. The small ringlet butterfly which is usually abundant was scarcely seen at all. In fact, the number of species of various orders which were reduced by the drought would make an extensive list.

On the other hand, a few species either were unaffected or were benefited by the weather conditions. A heavy infestation of the aphis *Myzocallis punctatus* Monell occurred on Garry Oaks throughout the southern end of Vancouver Island, in fact, the worst that had occurred in recent years. This infestation did not result from an exceptionally favourable supply of moisture but from other conditions which could have been a decrease of parasites and predators due to drought or other causes. Many other species of aphids were abundant. It is worth noting in this connection that Hemerobiids and Chrysopids were exceptionally scarce that year and very few Coccinellids and Syrphids were seen. The *Myzocallis* infestation was greatly reduced in 1952, was still less in 1953, and in 1954 the species had nearly disappeared, which suggests that if drought was responsible for the decrease of predators they required three years to recover their numbers. Also on Oak trees a small moth, *Gelechia trichostola* Meyr, occurred in

unusual numbers. This species was heavily reduced during the next two years. The codling moth was abundant on Vancouver Island and the long period of warm weather and higher average temperature induced a partial second generation which is unusual at the coast. Other economic species which showed an increase were the apple leaf skeletonizer, *Anthophila pariana* (Clerck); the cherry fruit flies, *Rhagoletis cingulata* (Loew) and *R. Fausta* O.S.; the European earwig, *Forficula auricularia* L.; *Typhlocyba ariadne* McA. and *T. tenerrima* H.S. on loganberries; *Lecanium coryli* (L.); *Polyphylla perversa* Csy. in strawberries; the strawberry crown moth *Ramosia bibionipennis* (Bdvl.); cutworms and wasps.

In the lower Fraser Valley insects appeared to be affected in much the same degree as on Vancouver Island. Most species were greatly reduced in numbers. During the latter part of the summer very few insects were present on trees and shrubs, except where abundant moisture was available as in the case of poplars or other species growing near water or where watering was carried out in cities.

It is fairly obvious that the principal cause of the high mortality among Heteroptera, Lepidoptera and most of the Homoptera was the destruction of food plants. The reason that a number of species were able to increase and others maintained normal numbers is not clear, although most of them were tree or shrub feeders, which have a distinct advantage over grass and herb feeders in a dry season. But the factors governing insect populations are tremendously involved and include the presence or absence of predators, parasites and diseases. These in turn may be affected by temperature, moisture and humidity. The tolerances of insects with regard to temperature, moisture and humidity vary according to the species and although rains may fall in an otherwise normal season, it is important that they fall at the right time to provide sufficient humidity at the critical period of development for any individual species. Writers on the subject have suggested various results from the lack of sufficient humidity. Ludwig (1945, p. 107) states: "Ludwig and Anderson (1942) observed that, when the eggs of Saturniid moths were exposed to low humidity, many more larvae developed than emerged. In dry air many larvae pierced the shells but died without emerging. Hence, in these eggs the chorion is very efficient in preventing evaporation, retaining this function until pierced by the emerging larvae. Thereupon the larvae lose water so rapidly in dry air that very few of them are able to hatch." . . . "In some cases the limits of humidity which permit hatching are narrower than those which permit development, indicating that at the lower humidities, death occurs because the larvae are so weakened by loss of water that they cannot emerge or because desiccation hardens the chorion to such an extent that the larvae are unable to escape", (Pyenson and Sweetman, 1931).

The degree of humidity definitely influences the reproductive capacity of insects. "Low humidity may reduce the number of eggs laid by interfering with the mechanism of oviposition". (Ludwig 1945, p. 110). A combination of heat and dryness may cause desiccation of the pupae of insects. This is evidenced in the well-known case of the Hessian fly, for which drought conditions are unfavourable, since the larvae and pseudopupae are easily killed by dryness. The adults also die prematurely without realizing their productive abilities. Eggs do not hatch successfully, or young larvae are unable to reach the tender parts of the stem.

The recovery of Heteroptera and Homoptera after the year of drought was, for a large number of species decidedly slow. In 1952, except for those species which are always reasonably abundant, few insects were collected even in favourable spots, although the summer rainfall was slightly above the average. In 1953

there was an increase in numbers although still not up to the average. What I would consider normal conditions were not reached until 1954, although even then certain species were still absent. Those species which I mentioned as occurring in abnormal numbers in 1951 were reduced to minimum populations the following year, which is usually what happens following over-abundance. To correctly assess the effect of weather variations on insects is a most difficult matter for, apart from the direct effect of destruction of food plants, intolerance to excessive heat and low humidity, the actions of predators, parasites and diseases have to be taken into account, and as these vary with each species, the problem becomes exceedingly complex. Periods of abundance may be long or short according to the species, and weather cycles may have a direct effect on the length of these periods. Thirty-five years ago many species of Heteroptera and Homoptera were much more abundant than they are now. I have not seen some of the species which were abundant then, for twenty years or more; and some have re-occurred only occasionally. But eventually when favourable conditions return, each species will regain its former abundance.

References

Ludwig, D. The effects of atmospheric humidity on animal life. Physiological Zool., 18:103-135. 1945.

Ludwig, D., and J. M. Anderson. Effects of different humidities, at various temperatures, on the early development of four Saturniid moths . . ., and on the weights and water contents of their larvae. Ecology 23:259-274, 1942

Pyenson, L., and H. L. Sweetman. The effects of temperature and moisture on the eggs of *Epilachna corrupta* Mulsant (Coccinellidae, Coleoptera). Bull. Brooklyn Ent. Soc. 26:221-226, 1931.

NOTES ON THE LIFE HISTORIES OF FOUR SPECIES OF MOTHS (LEPIDOPTERA: PHALAENIDAE) INDIGENOUS TO VANCOUVER ISLAND, BRITISH COLUMBIA

GEORGE A. HARDY

Provincial Museum, British Columbia.

Among several life histories and partial life histories, worked out during the year 1954 the following are submitted as a contribution to our knowledge of local entomology.

Ulosyneda subtermina Sm.

This is a Western American species, occurring from British Columbia to California. In British Columbia it seems to be confined to Vancouver Island, wherever its food plant the Garry Oak (*Quercus garryana*) grows. Information regarding the early stages is not readily obtainable, at any rate I am not aware of any published records.

Although not a conspicuously coloured moth it is quite distinctive, with shades of ashy brown dotted with black at tip of forewings, and etched with darker lines, unlike any other moth of similar size and appearance. It measures one and one half to one and three quarter inches (40-47mm.) in wing expanse. It is a night flier, and is readily attracted to artificial light in the vicinity of the Garry oak during the months of April and May.

Material for the present account was obtained in a light trap. A female taken on May 11 was confined

in a jar with several dead oak leaves. Twenty-five eggs were laid in a compact group under one of the leaves where it was in close contact with the bottom of the jar, suggesting what in fact is the case, that the ovipositor is long and flexible enabling the moth to lay her eggs well into the crevices of bark or twig.

Ovum. Laid May 11th. Size 1 by 1 mm. At first globular, soon losing this form due to pressure of the other eggs or contact with the substratum; shell very fragile, membranous, hyaline, easily conforming to the irregularities of site and position, more or less translucent, with very faint ribs and cross ribs, contents showing as an amorphous creamy substance. During the development of the larva within the egg the only change noted was an obscure dark spot in the centre of the creamy contents.

Larva

1st Instar. May 22; newly hatched larva 4 mm. in length. It did not eat the egg membrane. Bilobed head and cervical plate shiny, dark chocolate in colour. Body smooth with segments well marked by intersegmental constrictions, colour a very pale translucent green. Three pairs of claspers. The young larva is very active, looping along rapidly and with much swinging of the body in all directions, evidently in search of food. When disturbed it emits a light silken thread that prevents it from falling to the ground. At all times it avoids the light, feeding between the Garry oak leaves or within their curled edges. When at rest it stretches out along the underside of a leaf.

2nd Instar. May 28; length 5-7 mm. Head dark brown or black. Body colour now light green to blue grey, with a series of six longitudinal indistinct or interrupted pale brown lines; spiracles black. At a later stage in the second instar the subdorsal lines show a well marked intermittent thickening and thinning on each segment, giving the effect of a series of short dashes, one on each segment. Below the subdorsals are two very thin whitish lines followed by a broader light grey spiracular line. The spiracular line merges into the dull soiled-white colour of the underside. The larva is negatively phototropic. If exposed to the light it lies still momentarily, then rapidly wriggles under cover of the leaves or the scraps of lichen-covered bark provided for it.

3rd Instar. June 9; length 10 mm. Head black. General colour grey to bluish-green. A faint bluish-green dorsal line. Subdorsals with well marked bracket-like dashes on each segment. A dark spot between the dashes gives a chain-like appearance to each of the subdorsals. Several fine milky white lines between the subdorsals and the spiracular line. As it grows larger the larva tends to abandon the leaves when not feeding, which is only at night, and seeks the cover of the bark and lichens at the bottom of the cage. It closely resembles the lichens among which it lies and from which it is almost indistinguishable.

4th Instar. June 20; length 20 mm. Head square, black on lower part of front blending into grey-green on vertex, an oblique fuscous dash on each side, cervical plate grey-green marked with two parallel dark brown bars one on each side. Body dark fuscous olive, a faint white-edged bluish dorsal line, subdorsal interrupted marks very conspicuous, these marks slightly curved, the convex side towards the dorsum. Ground colour of body finely etched with drab olive colour. Length at end of 4th instar 30-35 mm.

5th Instar. June 27; length 32-34 mm. Head as before, colour pattern intensified by contrasting light and dark greys, dorsum of body segments with a pale grey-green anchor, or hour-glass-shaped marking. Thickened sections of the subdorsals conspicuous, a broad light grey super-spiracular line blends into the pale drab colour of the underside. Five well-developed claspers, those on the fourth and fifth abdominal segments having developed

during the last two or three moults. Length, just before pupation, averaged 42 mm.

Pupa. Pupation took place July 18 in a light cocoon spun among the debris at the bottom of the container. Length 20 mm. x 5 mm. slender, tapering posteriorly, surface dull, colour dark reddish-brown, cremaster consisting of two stout, straight, widely spaced spines, and a short slender one at the base of and on the outer side of each of the larger spines.

Summary. The eggs are laid in the spring, presumably in a crevice of the bark or between bud scales, their flexible texture allowing of a close application to the irregularities of the suffface on which they may be deposited. The larva is very active when first hatched. Throughout all instars, the larva is negatively phototropic. It hides at first among the leaves, later in the crevices on the bark among the lichen growth, the colour and marking of which it resembles. At first possessing only three pairs of claspers it develops an additional two pairs in the last moults. At all times the larva is essentially an individualist.

In 1954, eggs laid May 11 hatched on May 22, 11 days; 1st instar 6 days; 2nd instar, May 28, 12 days; 3rd instar June 9, 11 days; 4th instar, June 20, 7 days. The 5th instar began June 27 and lasted 22 to 28 days, the feeding period being about 16 days, the larva remaining quiescent in the cocoon for a week or so before pupating. Pupated July 18 to 24, *i.e.*, 69 to 75 days from egg to pupa.

Caenurgina erechtea parva Blkme

The forage looper or common grass moth is widely distributed in North America from coast to coast in open grassy places where it flies on sunny days. It occasionally comes to artificial light.

In British Columbia it is double brooded, the spring form being considerably smaller than the summer one. It was to the small spring form that Blackmore (1920) gave the name *parva*. Ferguson (1953) in his Lepidoptera of Nova Scotia, also mentions the small spring form of this species, so this seasonal dimorphism apparently occurs over a wide range. I have no evidence yet as to whether the summer form passes the winter in the pupal or larval stage. This might have a bearing on the occurrence of the smaller specimens of spring. In some species of moths, for instance, *Xanthorhoe defensaria*, the spring form is the largest.

Eggs were obtained from an individual of the summer brood (*erechtea*) on July 26, 1953. These hatched on August 4 but all the larvae died from lack of the proper food plant which was not known at that time. As the commoner vetches, which constitute the food plant of the spring brood, are drying up at that season of the year, there may be an alternate and as yet unknown food plant of a more succulent type.

Ovum. Female taken in the Hudson's Bay Woods, Victoria, Vancouver Island, laid 30 ova on May 4, 1954. They were scattered about the bottom of the box, each one lightly cemented to the surface. Length about 1 by 1 mm., spherical and finely ribbed, colour grass-green, irregularly spotted with brown.

Larva

1st Instar. May 18, length 3 mm. Head colourless. Body translucent, three pairs of claspers. Very active, looped rapidly about, emitting a light silken thread as it proceeded. Did not eat shell. Fed on *Trifolium pratense*, *Vicia sativa*, *Trifolium dubium* and *Lathyrus nuttallii*; it nibbled at *Dactylus glomerata*, but preferred *Vicia sativa*.

2nd Instar. May 24, length 6 mm. Head pale brown, body green with six thin brownish longitudinal lines; spiracles black, claspers brown at tip.

3rd Instar. June 2, length 10 mm. Head light brown with darker brown and white stripes. Body grey green to blue grey; four double longitudinal brown stripes continuous with those on the head. Under side grey with four dark brown longitudinal lines.

4th Instar. June 11, length 15 mm. Colour and markings as before except that the under side has a black white-edged central line flanked by three thin fuscous lines on each side, thoracic legs dark brown. When disturbed raises the front part of body, doubling the head back along the under side. When at rest it lies closely appressed in full length along the stem of food plant. As the body tapers slightly at each end it blends into the stem, the double longitudinal lines further helping to camouflage it.

5th Instar. June 20, length 25-35 mm. Head light brown with lines as before although some larvae have head black with a central light brown line; body brownish to fuscous, original double lines less strongly marked. By July 12 it was full-fed. General colour a dead-grass shade of yellowish-brown varying from light ash to sienna brown in some individuals; the double lines traceable and with numerous fine lines and vermiculations between that help to break up the solid effect of a plain colour. Most of the lavae pupated at this time, spinning a light cocoon among the leaves of the food plant.

Pupa. Length 17 mm. x 5 mm. Reddish-purple colour with a glaucous bloom; cremaster consisting of four separated hooked spines in a row along the broad tip of the last segment.

Imago. On August 5, four emerged; on August 6, one; on August 7, five; August 8, two; August 11, two; all females but one. Thus fourteen adults were reared from thirty eggs. These were the large or summer brood originally described as *erechtea.*

Caenurgina erechtea measures one and one half inches (42mm.) across the expanded wings; while in the form *parva* it is only one and one quarter inches (34 mm.) from tip to tip.

Summary. Egg May 4 - 18 (14 days). Larva May 18 - July 12 (46 days). Pupa July 12 - August 5 - 11 (27 days approximately). Total period from egg to adult averaged about 87 days.

Caenurgina caerulea Grt.

The blue grass moth occurs only in the Pacific coastal regions; in British Columbia it is found on Vancouver Island and in the Lower Fraser valley where it frequents grassy fields, and open slopes on hillsides at slightly higher elevations than *erechtea.* It is on the wing from April to June, flying by day in bright sunshine.

The blue grass moth has the distinction of being one of the very few blue moths. It measures one and one quarter inches (32 mm.) across the expanded wings.

Ovum. A female taken on Wells Mountain, Goldstream, Vancouver Island, laid a batch of 30 eggs on June 9, 1954, scattered and lightly cemented to bottom of box. Size .8 mm. x .8 mm. globular, with about 30 fine ribs, slightly flattened at point of adherence to substratum. Colour, grass-green becoming spotted with brown as development proceeds. Hatched on June 27.

Larva

1st Instar. Length 3 mm. Very slender. Head pale brown, body colourless, translucent, a few long hairs on each segment. All hatched by June 29. Very restless; did not eat egg shell. Fed on *Vicia sativa* and *Lathyrus nuttallii.* Used a silk thread when moving about. Has three pairs of claspers.

2nd Instar. July 5, length 6 mm. Head pale brown; body smooth, hyaline showing green patches due to ingested food, two black longitudinal lines on dorsum, underside light grey. Towards the end of this instar the colour was more decided; blue-grey with double lines as in *C. erechtea.*

3rd Instar. July 19, length 15 mm. Colour light brownish, otherwise as before. Rested with body stretched out and closely applied to the stem, head and anal claspers extending along the stem so that the body seemed to be part of it.

4th Instar. July 28, length 25 mm. Very similar to *erechtea* but no black lines on underside. July 31, length 30 mm. General colour beige or dried

grass colour. Dorsal, subdorsals and spiracular lines with a fine grey line down centre of each one giving the effect of double lines (several finely etched lines between are not conspicuous). Underside with a small hyphen-like mark on centre of each segment. There was a tendency for all the markings to become less noticeable as the larva grew older.

5th Instar. August 15, length 35-40 mm. Head, beige to pale pinkish brown. General colour a dead grass hue tinged with pink, the four longitudinal double lines extending along the sides of the head as before, though very faintly marked. Development of the individual larvae was very irregular, some attaining twice the size of others towards the end of the larval life; hence pupation extended from August 21 to September 2. A light cocoon was spun among the leaves of the food plant.

Pupa. Length 13 mm. x 4 mm. Slender with a light bluish "bloom"; intersegmental areas of abdomen orange-brown, cremaster of two long and several short bristles with recurved tips in a transverse row on rounded tip of segment.

Summary. Egg June 9 - June 27 (19 days). Larva June 27 - August 25 (approximately 60 days). Pupa August 25 - May or June of the following year, 8-10 months. Total period egg to adult approximately 360 days.

Discussion. Considering the difference in size and colour of *erechtea parva* and *caerulea*, the ova, larvae and pupae are remarkably similar. In *erechtea parva* the larva is larger when full grown, and has several dark longitudinal lines on the underside. The pupa is also larger with the tip of the cremaster bearing four large spines, whereas in *caerulea* there is only one interrupted dark line on the underside. The pupa of *caerulea* has two large spines and several small ones on the cremaster.

The period of development from egg to pupa is sixty days in *parva* and eighty days in *caerulea*.

Polia liquida Grt.

Polia liquida is a medium-sized moth measuring about one and one half inches across the expanded forewings. the general colour is a dark grey with strongly contrasting silvery-white markings. It is nocturnal and readily attracted to artificial light during the flight season, from May to June on Vancouver Island. *P. liquida* is a western North American species. In British Columbia it is recorded from southern Vancouver Island and Kaslo (Jones, 1951); elsewhere it occurs in the coastal states south to California (Dyar, 1902) and east to Montana (Cook, 1930). Farther east it is replaced by closely allied species.

Ovum. A female taken at light on June 30, 1954, at Braefoot, Saanich, Vancouver Island, laid a batch of 40 eggs on July 4. They were deposited in a compact layer adherent to the bottom of the container. Size 0.9 by 0.7 mm., orbicular, slightly flattened from above with about 30 strongly marked vertical ribs, reticulate in the micropylar area; colour, pale cream changing through vinaceous pink to a dark pinkish-red at hatching time.

Larva

1st Instar. July 14, length 3 mm. Head pale brown. Body colourless with large black tubercles, about eight to each segment. The larva eats the egg shell and is very restless, not feeding until about twenty hours later. It nibbled at *Agropyron repens, Lathyrus nuttallii,* and *Rumex crispus* the last of which it much preferred and on which it was reared to maturity. When alarmed it rears up, bending the head and fore part of the body downwards in a question-mark-like attitude.

2nd Instar. July 30, length 7 mm. Head pale brown, body pale greenish or in some individuals a fuscous colour with bluish dorsal and subdorsal lines, a broad whitish spiracular line edged with black along the upper side. Underside honey-colour, third and fourth pairs of claspers more strongly developed than the first and second. One larva was observed to forcibly remove an obstinate pellet with its jaws.

3rd Instar. Length 16 mm. Head pale brown with two vertical dark brown bars, body fuscous or brown, the longitudinal lines a pale lemon colour, spiracular line white to yellow edged above with dark brown.

4th Instar. August 17, length 25-28 mm. Head as before, body a dark chocolate colour, all the stripes, including the spiracular, a pale lemon colour each finely edged with black.

5th Instar. August 26. Length 35 mm. Head pale brown with four vertical fuscous bars, body chocolate with strongly contrasting black-edged yellow dorsal, subdorsal and spiracular lines. In some cases body colour is black between dorsal and subdorsals, vinaceous between subdorsals and spiracular, underside vinaceous, shading into beige. Length when full-fed 40 mm.

As the larva grew older it rested quietly, when not feeding, extended along a leaf-stalk or on the mid-rib on the underside of a leaf, the yellow stripes of the larva tending to blend it into the leaf or stalk. If touched it rolled into a ring and dropped to the bottom of the container.

Pupa. Pupated September 7 and 8. Pupa 17 mm. x 5 mm., slender, thorax with fine transverse rugosities or wrinkles, abdominal segments coarsely punctate except for a smooth central band on the first three; colour dark mahogany brown; cremaster a stout dorso-ventrally flattened process terminating in two parallel spines, the whole 1 mm. long. The larva made a cocoon of earthen particles cemented together with silk, just beneath the surface of the ground.

Summary. Ovum, July 4 - 14 (10 days). Larva July 14 - September 8 (57 days). Pupa September 8 - May or June (8-10 months). Total days from egg to adult approximately 365 days.

References

Blackmore, E. H. Can. Ent. 52:266. 1920.

Cook, W. C. "An ecologically annotated list of the Phalaenidae of Montana". Can. Ent. 62:12, 273. 1930.

Dyar, H. G. "A list of North American Lepidoptera and key to the literature of this order of insects". U.S. Nat. Mus. Bull. 52. 1902.

Ferguson, D. C. "The Lepidoptera of Nova Scotia". Proc. Nova Scotia Inst. of Sci. 23:161-375. 1953.

Jones, J. R. J. Llewellyn. "An annotated check list of the Macrolepidoptera of British Columbia. 1951.

Insect Population in Pigeon Manure

On February 16, 1954, a citizen brought me about a gallon of pigeon manure from the belfry of an old church in Vancouver, stating that it was a sample from some two tons that had accumulated over the years. A farmer had contracted to remove the manure. Finding certain insect larvae in it, he wondered if the insects would be detrimental to his greenhouse crops and asked his friend to have the material examined.

The manure was fairly solid and compressed, damp and heavy with odd sticks and feathers and the remains of a dead bird incorporated into it; the surface, of recent deposition, was dry and flaky. There was relatively little smell to it.

Picked over bit by bit, it yielded:—

1. Scores of larvae of *Tenebrio molitor* L., the yellow meal worm, in all sizes and instars from very small to mature—but no pupae or adults; there was one elytron.
2. Many dead adults of *Sitodrepa panicea* L., the drugstore beetle, but no larvae.
3. Two adult *Ptinus fur* L., the white-marked spider beetle, and one larva, all alive.
4. Several small Staphylinid bettles.
5. Moth larvae of two distinct species, one fully ½ inch long, active, and non-silk spinning.
6. A few empty cases of *Tinea pellionella* (L.), the case-making clothes moth.
7. A number of full grown, thin, thread-like larvae of *Scenopinidae*, window flies. These maggots have distinct heads and are predacious.
8. Many predacious, small Hemiptera, two adults and the rest nymphs. I have not identified them yet.
9. Two half grown, living *Lepisma saccharina* L., or silver fish,
10. Two empty puparia of, probably, blow flies.

To my surprise, there were no mites and no larvae of muscoid Diptera; none of the insects was of much nuisance value. —*G. J. Spencer, University of British Columbia.*

CHEMICAL CONTROL OF *LYGUS* SPP. (HEMIPTERA:MIRIDAE) IN BRITISH COLUMBIA PEACH ORCHARDS*

M. D. PROVERBS**

Entomology Laboratory, Summerland, B.C.

Before 1949, the quantity of marketable fruit from many peach orchards in the interior of British Columbia was appreciably reduced because of malformed peaches. Most of this malformation was due to the feeding of *Lygus* bugs, which are particularly abundant where alfalfa cover crops are grown. The only feasible means of controlling these insects was by disking under the cover crop in the fall, and frequently this practice was not very successful.

From 1947 to 1952, experiments were conducted in peach orchards throughout the Okanagan Valley of British Columbia on the control of *Lygus* bugs with DDT and other organic insecticides.

Materials and Methods

In the early experiments, the insecticides were applied as dusts to the orchard cover crops only, but as the work progressed the peach trees were sprayed, generally with a mist-blower sprayer. The area of each treated block was usually about one acre; treatments were not replicated. Control of *Lygus* bugs was estimated from the percentage of malformed fruits at thinning time and at harvest. The insecticides, their amounts and the stages of tree development at which they were applied are given in Tables I to VII.

Results and Discussion

In three orchards where the cover crop alone was dusted (Table I), it was only in the first orchard, treated with DDT at the balloon-bud stage of peach, that the percentage of malformed fruit at harvest in the treated block was appreciably lower than in the check block. In the other orchards, the insecticides were probably applied too early (early balloon-bud stage of peach) for the most effective control of *Lygus* bugs.

TABLE I.—Malformed Fruit at Thinning Time and at Harvest After Dusting the Cover Crop in Three Peach Orchards with DDT or BHC, 1947.

Orchard	Material	Approximate Amount per Acre	Stage of Peaches when Cover Crop Dusted	Fruit Malformed %[1]	
				Thinning Time	Harvest
1	DDT, 3% dust[2]	80 lb.	Balloon-bud	—	7.4
	Check	No treatment		—	19.7
2	DDT, 3% dust	150 lb.	Early balloon-bud	—	9.7
	Check	No treatment		—	9.1
3	BHC, dust[3] 2% gamma isomer	2.3 lb. gamma isomer	Early balloon-bud	8.3	6.4
	Check	No treatment		10.1	7.2

[1]Each figure is determined from 1500 fruits examined at random.
[2]Ansell Laboratories Limited, Vernon, B.C.
[3]Shanahan's Limited, Vancouver, B.C.

* Contribution No. 3331, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.
** Associate Entomologist

On the basis of the percentages of malformed fruit at harvest, the population of *Lygus* bugs was evidently reduced where peach trees were sprayed twice with a mixture of BHC, stove oil, and Velsicol AR-50 (Tables II and III). Strict comparisons cannot be made since two orchards were involved and the dosages of the chemicals were slightly different in the two orchards. However, where the BHC spray was applied at 95 per cent petal-fall and again at 95 per cent shuck-fall (Table II), the percentage reduction in malformed fruit at harvest was similar to that obtained when it was applied at the late balloon-bud stage and again at 95 per cent shuck-fall (Table III). On the basis of the percentages of malformed fruit at harvest, the BHC spray in the latter orchard appeared to give only slightly better control of *Lygus* bugs than a mixture of DDT, stove oil, and Velsicol AR-50. According to the grower, however, in previous years damage from *Lygus* bugs had always been more severe in the area in which the BHC and check blocks were situated, because of a dense alfalfa cover crop, than in the DDT block, where there was virtually no alfalfa. The superiority of BHC over DDT was, therefore, probably greater than indicated by the percentages of malformed fruit. The poorer results with DDT were, no doubt, largely due to the low dosage (one pound of DDT per acre) used in the experiment.

TABLE II.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees with a Mixture of BHC, Stove Oil, and Vilsicol AR-50 at about 95 per cent Petal-fall and again at about 95 per cent Shuck-fall, 1948.

Material	Approximate Amount per Acre per Application	Fruit Malformed, %[1]	
		Thinning Time	Harvest
BHC wettable powder[2] 6% gamma isomer Stove oil[3] Velsicol AR-50[4] Duponol WA flakes[5]	0.75 lb. gamma isomer 9.0 pints 9.0 pints 2.0 oz.	5.3	8.6
Check	No treatment	11.2	13.7

[1]Each figure is determined from approximately 2000 fruits examined at random.
[2]Canadian Industries Limited, Montreal, Que.
[3]Approximately 32 S.S.U. Vis. 100°F., over 75 per cent U.R.; Shell Oil Company, Penticton, B.C.
[4]A methylated naphthalene; Velsicol Corporation, Chicago, Ill.
[5]Forty to forty-two per cent sodium lauryl sulphate; Canadian Industries Limited, New Westminster, B.C.

Good control of *Lygus* bugs was obtained in two orchards where a mixture of DDT, stove oil, and Velsicol AR-50 was applied at about 90 per cent petal-fall and again at about 90 per cent shuck-fall (Tables IV and V). Control was slightly less where trees were sprayed at 90 per cent petal-fall only, but the percentage increase in malformed fruit was not sufficiently great to justify the additional expense of the second application (Table V).

TABLE III.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees at the late Balloon-bud Stage and again at about 95 per cent Shuck-fall with a Mixture of Stove Oil and Velsicol AR-50 containing DDT or BHC, 1948.

Material	Approximate Amount per Acre		Fruit Malformed, %[1]	
	Balloon-bud	Shuck-fall	Thinning Time	Harvest
DDT[2]	1.0 lb.	0.75 lb.	15.5	12.5
Stove oil	1.0 pint	—		
Velsicol AR-50	0.5 pint	—		
Nacconol NR[3]	1.0 oz.	—		
BHC wettable powder 6% gamma isomer	1.0 lb. gamma isomer	1.0 lb. gamma isomer	—	10.2
Stove oil	2.0 gal.	1.0 gal.		
Velsicol AR-50	0.5 gal.	—		
Duponol WA flakes	8.0 oz.	6.0 oz.		
Check	No treatment	No treatment	14.9	19.2

[1]Each figure is determined from approximately 1700 fruits examined at random.
[2]Technical, Monsanto Chemical Company, St. Louis, Mo., at the balloon-bud stage; 5 per cent powder, Ansel Laboratories Limited, Vernon, B.C., at the shuck-fall stage.
[3]An alkyl aryl sulphonate; National Aniline Division, Allied Chemical and Dye Corporation, New York, N.Y.

TABLE IV.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees with a Mixture of DDT, Stove Oil, and Velsicol AR-50 at about 90 per cent Petal-fall and again at about 90 per cent Shuck-fall, 1948.

Material	Approximate Amount per Acre		Fruit Malformed, %[1]	
	Petal-fall	Shuck-fall	Thinning Time	Harvest
DDT, technical[2]	9.0 lb.	6.0 lb.	2.5	2.8
Stove oil	1.5 gal.	1.0 gal.		
Velsicol AR-50	1.5 gal.	1.0 gal.		
Duponol WA flakes	3.0 oz.	3.0 oz.		
Check	No treatment	No treatment	27.4	14.3

[1]Each figure is determined from approximately 3300 fruits examined at random.
[2]Pennsylvania Salt Manufacturing Company, Tacoma, Wash.

A petal-fall spray of DDT gave slightly better control of *Lygus* bugs than a balloon-bud spray (Table VI). The percentage differences in malformed fruit from sprayed and unsprayed trees were not great, suggesting that control was not particularly good. However, this was probably not so, for the initial population of *Lygus* bugs was much greater in the sprayed blocks, where there was an abundance of alfalfa, the preferred host of *Lygus* bugs, than in the check block, where there was virtually no alfalfa.

TABLE V.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees with a Mixture of DDT, Stove Oil, and Velsicol AR-50 at about 90 per cent Petal-fall and again at about 90 per cent Shuck-fall, or at about 90 per cent Petal-fall only, 1948.

Block	Material	Approximate Amount per Acre		Fruit Malformed, %[1]	
		Petal-fall	Shuck-fall	Thinning Time	Harvest
1	DDT, technical[2] Stove oil Velsicol AR-50 Duponol WA flakes	4.9 lb. 7.3 pints 7.3 pints 1.6 oz.	6.0 lb. 8.0 pints 8.0 pints 2.0 oz.	1.3	2.2
2	Same as Block 1	Same as Block 1	No treatment	3.2	3.1
3	Check	No treatment	No treatment	16.7	14.8

[1]Determined from approximately 2500 fruits examined at random in each block.
[2]Monsanto Chemical Company, St. Louis, Mo.

As a result of these and other experiments not reported here, a petal-fall application of DDT is recommended for the control of *Lygus* bugs in British Columbia peach orchards. The petal-fall spray of DDT was considerably more important than the shuck-fall spray, and slightly more effective than the balloon-bud spray (Tables V and VI). Chandler (1950) found that, in Illinois, a DDT spray applied when 50 per cent of the peach blooms were open gave even better control of *Lygus* bugs than a petal-fall spray. However, as Snapp (1947) has pointed out, the petal-fall application is preferable, in order to avoid poisoning insect pollinators, even though insects do not play an important role in the pollination of peaches. In British Columbia, cherry trees are often interplanted with peaches. As cherries bloom at approximately the same time as peaches, and as insects are essential for the pollination of many varieties of cherry, every precaution should be exercised to safeguard insect pollinators.

A petal-fall spray of parathion gave slightly better control of *Lygus* bugs than a DDT spray applied at the same stage (Table VII). However, work with parathion was discontinued because of its extreme toxicity to man.

TABLE VI.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees with 50 per cent DDT[1] Wettable Powder at 16 lb. per acre at about 90 per cent Petal-fall, or at the Balloon-bud Stage, 1952.

Stage of Spraying	Fruit Malformed, %[2]	
	Thinning Time	Harvest
Petal-fall	2.0	1.2
Balloon-bud	4.0	1.4
No treatment	7.8	3.4

[1]General Chemical Company, New York, N.Y.
[2]Each figure is determined from approximately 1500 fruits examined at random.

TABLE VII.—Malformed Fruit at Thinning Time and at Harvest after Spraying Peach Trees at about 75 per cent Petal-fall with DDT, or Parathion, 1949.

Material	Approximate Amount per Acre	Fruit Malformed, %[1]	
		Thinning Time	Harvest
Parathion, 15% wettable powder[2]	7 lb.	3.2	2.5
DDT, 50% wettable powder[3]	15 lb.	6.1	6.7
Check	No treatment	22.0	26.0

[1]Each figure is determined from approximately 1200 fruits examined at random.
[2]Naugatuck Chemicals, Division of Dominion Rubber Company, Limited, Elmira, Ont.
[3]Pennsylvania Salt Manufacturing Company, Philadelphia, Pa.

It was feared that the use of DDT for the control of *Lygus* bugs in British Columbia peach orchards might result in an increase of phytophagous mites. To date, there has been no evidence that this has occurred, either in experimental or in grower-sprayed orchards.

Summary

Experiments conducted in British Columbia peach orchards from 1947 to 1952 indicated that the number of peach fruits injured by *Lygus* bugs was appreciably reduced by spraying the trees with DDT. Best results were obtained with a mixture of DDT, stove oil, and Velsicol AR-50 applied at 90 per cent petal-fall and again at 90 per cent shuck-fall. A single spray at petal-fall was almost as effective, and, on the basis of cost, the second application was not justified. Injury to fruit was also reduced by spraying with a mixture of BHC, stove oil, and Velsicol AR-50 at 95 per cent petal-fall and again at 95 per cent shuck-fall. Parathion at the petal-fall stage was slightly more effective than DDT at the same stage; work with parathion was discontinued, however, because of its extreme toxicity to man.

References

Chandler, S. C. Peach insects of Illinois and their control. Illinois Nat. Hist. Surv. Circ. 43. 1950.

Snapp, O. I. Experiments in 1946 on the control of bugs that cause deformed peaches. J. Econ. Ent. 40:135-136. 1947.

Mallis, Arnold. 1954. *Handbook of Pest Control* (2nd Ed.) **MacNair-Dorland Co., New York. Illus., pp. 1068**

This is a valuable reference book, handsome, well-bound and printed on good paper. Frankly aimed at pest control operators, it will nonetheless prove useful to anyone likely to be consulted about household or industrial pests. Its worth is attested by the fact that it is in a second edition after nine years.

Obviously it is not possible to pass judgment on the hundreds of control methods culled from papers, so that discussion must centre on the arrangement and presentation. Here the book is open to criticism. More condensation, and judicious pruning of long quotations would help to avoid redundancies such as this: of poisoned rats, Mallis quotes: "Of course, the odor can be quickly abated if the dead animal is found and removed" (p. 94).

A useful addition, whether or not the reader were familiar with insects, would be master keys after the style of Metcalf and Flint, so that a completely unfamiliar pest could be tracked down quickly. The breakdown might be according to habitat, food, size, shape or Order. Already there are several very good, short keys in the text, giving distinctions within groups. The arrangement of sub-heads within chapters is not uniform, but an adequate index partly compensates for this lack. Each chapter ends with a good bibliography. The style is breezy and even colloquial.—*H. R. MacCarthy.*

SOME FACTORS REDUCING CARROT SEED YIELDS IN BRITISH COLUMBIA[1]

DAVID A. ARNOTT[2]

Field Crop Insect Section, Entomology Laboratory, Kamloops, B.C.

Commercial production of carrot seed in Canada is confined to British Columbia and most of it has for many years been grown at Grand Forks. In earlier years good yields were obtained, growers had little or no difficulty with pests or diseases, and returns were satisfactory. During the Second World War, when seed could not be imported, acreage was greatly increased to meet domestic needs. With the increase in acreage over a period of years, certain insects and diseases increased to such an extent that they caused serious damage to crops. Since the war, production has declined because of (1) the availability of imported seed at competitive prices and (2) the marked reduction in yields resulting from damage by insects, diseases, and some other factors. Although imported seed has to a considerable extent replaced home-grown seed it is considered that domestic production can still be profitable if satisfactory yields can be obtained. This paper deals with the chief factors in reduced yields in recent years.

Insect Pests

During 1947 and 1948 heavy infestations of a plant bug caused severe reductions in carrot seed yields at Grand Forks (Handford, 1949). At that time the insect was identified by the Taxonomic Unit, Ottawa, as *Lygus campestris* (L.), a European species recorded by Knight (1917, 1941) as widely distributed in North America and a pest of celery in Eastern Canada. (Brittain 1918) recorded this species as injurious to parsnip seed in Nova Scotia, and Matthewman (1941) reported damage by it to celery in Ontario. The bug is recorded by Alexander (1943) and by Whitcomb (1953) as a pest of celery in Massachusetts. Parshley (1919, 1921) refers to it as having been taken in the interior of British Columbia during 1917, but it had not been known as a crop pest in the province until 1947. In 1952 specimens of the bug from infested carrot seed fields at Grand Forks were identified by Mr. L. A. Kelton (in litt.), Entomology Division, Ottawa, as of a Nearctic species, *L. scutellatus* (Uhl.), the identity of which had been established by Wagner and Slater (1952). There is now much doubt that *L. campestris* occurs in North America. It is very likely that the earlier records concerned *scutellatus*. Strickland (1953) has recorded *scutellatus* from various localities of southern Alberta.

Subsequent study by the author showed that *L. scutellatus* is widely distributed in the southern interior of British Columbia, where it normally breeds on wild unbelliferous plants such as cow parsnip (*Heracleum lanatum* Michx.), water hemlock (*Cicuta douglasii* Coult. and Rose), and hemlock water parsnip (*Sium cicutaefolium* Schrank.). The bug was also found infesting seed plants of parsnip and dill at Grand Forks, but seed damage was negligible. Infestations have occurred annually in seed crops at Grand Forks since 1947 but none have been observed elsewhere except in one field at Armstrong in 1949 (Handford and Neilson, 1949). The insect has not been found damaging carrot root crops, the only case of infestation so far observed being a single adult taken in a field at Armstrong during 1953 by Dr. R. H. Handford, Officer-in-Charge of the Kamloops laboratory.

Experiments conducted by Handford (1949) demonstrated that *L. scutellatus* could be controlled with DDT and the seed yield doubled as a result. The outbreak subsided in 1949 and since then no significant damage has

1 Contribution No. 3343, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.

2 Associate Entomologist.

TABLE I.—Effects of Diseases on Germination and Yield of Carrot Seed, Grand Forks. B.C., 1952 and 1953.

Field	Percentage of growing plants affected by		Percentage of plants killed by root rots early in season	Germination %	Seed yield lb. per acre
	Blight	Black rot			
Starchuck, 1952	6	3	trace	—	1674
Cutt, 1952	trace	trace	trace	85	764
Cutt, 1953	0	2	3	71	821
Moore, 1953[1]	2	3	8	78	780
Moore, 1952	10	4	8	—	695
Holobofl, 1953[1]	trace	5	9	80	634
Abrosimoff, 1952	trace	5	30	85	614
Semenoff, 1952	4	3	32	87	597
Big-Y, 1952	15	8	20	86	563
Peterson, 1952	trace	4	41	87	545
Kazakoff, 1952	77	trace	trace	85	527
Semenoff, 1953	trace	10	25	84	320
Wirischagin, 1952[2]	76	many	trace	86	242
Samsonoff, 1952[1]	2	25	3	88	110

[1]Part of crop damaged by wireworms.
[2]Crop severely infected with aster yellows virus.

been caused by this species in British Columbia. As the insect is a native species established on wild host plants throughout the southern interior of the Province, it is reasonable to assume that outbreaks may occur again.

Surveys made by the author at Grand Forks during 1951 and 1952 showed that many kinds of insects frequent carrot seed crops, most of them being harmless. Some are beneficial as crop pollinators or as predators of injurious species. However, several kinds that might be injurious were present in most fields. These included springtails, thrips, aphids, leafhoppers, wireworms, grasshoppers, and various plant bugs, including several other species of *Lygus* than *L. scutellatus*. Large numbers of springtails, thrips, and leafhoppers were found in some crops but they appeared to cause no serious damage. Populations of grasshoppers and plant bugs other than *L. scutellatus* have been very small and injury by them has been insignificant. Most crops are infested annually by small numbers of *Lygus elisus* Van. D., *L. lineolaris P.* de B., *L. atriflavus* Kgt., and *L. schulli* Kgt. In 1950 Dr. H. R. MacCarthy (unpublished), of the Kamloops laboratory, carried out an experiment at Grand Forks with adults of the *L. elisus-lineolaris* group by caging them on umbels in various stages of bloom and seed development. He found that 10 bugs feeding on umbels in the late-bloom stage for 10 days caused a marked reduction in seed yield but that at other stages of growth seed yield was not affected significantly.

Since the outbreak of *L. scutellatus* during 1947 and 1948, the only noticeable insect damage at Grand Forks has been caused by the Pacific Coast wireworm, *Limonius canus* Lec. Parts of one or two fields during each of the last three years have been infested. The wireworms attack roots soon after planting, so that many plants are killed early in the season or become so damaged that no bloom or seed develops.

Diseases

After the insect outbreaks of 1947 and 1948 crops generally improved but some growers still obtain yields much below average. In the absence of serious insect damage, observations were made to determine what other factors might be responsible. During 1948 Handford (1949) observed that in some fields many plants died within

a few weeks after planting, the roots having rotted completely. In 1950 Dr. MacCarthy (unpublished) observed that many plants in some fields showed symptoms of infection by a bacterial blight and that loss of plants from root rots ranged from 6 to 27 per cent. In 1951 the author observed similar infection of growing plants and that considerable plant loss resulted from root rots. In some badly infected fields, areas from 10 to 30 feet in diameter were devoid of plants and blank spaces of 2 to 20 feet along rows were common. Further study during 1952 and 1953 showed that diseases were the chief cause of marked reductions in yield.

Root rots are responsible for most of the plant loss from disease. Many infected roots rot completely soon after planting. Much of the loss is primarily due to black rot, caused by *Stemphylium radicinum* (Meier, Drechsl., and Eddy) Neerg. Roots may have only slight or incipient infection when planted in the field, but later rot so extensively that the roots wither and die before seed matures properly. Other rots are caused by *Sclerotinia scleratiorum* (Lib.) de Bary, *Botrytis cineria* Pers., and *Fusarium spp.* Bacterial rots, probably due mostly to *Erwinia carotovora* (L. R. Jones) Holland, also occur, and these frequently act as secondary rots following initial damage by the black rot organism. Fields surveyed by the author during 1952 and 1953 showed that root rots reduced some crop stands as much as 40 per cent.

Two other diseases that attack carrot seed crops are a bacterial blight, *Xanthomonas carotae* (Kendr.) Dowson, and yellows, caused by the aster yellows virus. The bacterial blight may affect the whole plant or only part, causing severe damage to plant tissues. Frequently complete or partial blasting of umbels by this blight destroys bloom and seed. Although blight has been common, it has not been severe enough at Grand Forks to seriously affect total crop yields.

Occurrence of the yellows disease is sporadic in some fields but in others it may be abundant, as in one field during 1952, when the entire crop developed a yellowish colour. The umbels were much smaller than normal. Many flowers became infertile due to imperfect formation. Yield from this field amounted to only 242 pounds of seed per acre compared with the average of 600 pounds. This disease is spread by a leafhopper during its feeding on plants and primary infection usually occurs the first year on steckling plants.

The effects of the diseases on seed production are shown in Table I. Crops with least infection produced the highest yields. The poorest yields were obtained from those crops severely infected with root rots. Although the diseases caused serious reductions in seed yields, they apparently had no adverse effect on germination, percentage germination of seed from badly infected crops being as high as that of seed from the least infected ones.

There are other factors that also tend to reduce yields. Low soil fertility, careless cultivation, and improper crop management, especially at planting and harvest, result in a certain amount of seed loss yearly, and no doubt these factors account for the variations within the infected and relatively uninfected crops.

Summary

Bacterial blight, black rot, several other species of root rot, and aster yellows virus damage carrot seed crops at Grand Forks, British Columbia. Black rot and the other root rots are responsible for most of the damage, and since 1948 these diseases have been the chief cause of serious reduction in seed yields. A native plant bug, *Lygus scutellatus* Uhler, caused severe reductions in yield during 1947 and 1948. It has not been a serious pest since that time but it is common and widely distributed throughout the southern interior of British Columbia, where it breeds on several wild species of Umbelliferae as

well as on seed crops of parsnip and dill; hence it may be assumed that outbreaks may occur again. Other species of *Lygus* have proved capable of reducing seed yields under caged conditions, but outbreaks have not occurred in carrot seed crops in British Columbia. Sporadic infestations of the Pacific Coast wireworm have occurred in some crops, but damage has not been serious. Other injurious insects infest carrot seed crops, but they have not caused serious damage at Grand Forks.

Acknowledgments

The author is indebted to Dr. R. H. Handford, Officer-in-Charge of the Kamloops laboratory, for data on the insect outbreaks of 1947 and 1948 and on control of the bug *L. scutellatus*. Data for 1950 on insect infestations, prevalence of disease, and damage done by bugs of the *L. lineolaris-elisus* group were kindly provided by Dr. H. R. MacCarthy of the Kamloops laboratory. For identification and appraisal of diseases attacking carrot seed crops, the author gratefully acknowledges the assistance of Mr. G. E. Woolliams, Associate Plant Pathologist, Plant Pathology Laboratory, Summerland, B.C. Wild host plants on which *L. scutellatus* breeds in the southern interior of British Columbia were kindly identified by Dr. T. M. C. Taylor, Head, Department of Botany, University of British Columbia, and Messrs, W. L. Pringle and A. McLean, Dominion Range Experiment Station, Experimental Farms Service, Kamloops, B.C.

References

Alexander, C. P.. Department of Entomology. *In* Annual report, 1942, 34-40. Massachusetts Agr. Expt. Sta. Bull. 398, 1943.

Brittain, W. H. Notes on *Lygus campestris* Linn. in Nova Scotia. Proc. Ent. Soc. Nova Scotia, 1918; 76-81. 1919.

Handford, R. H. *Lygus campestris* (L.): A new pest of carrot seed crops. Can. Ent. 81: 123-126. 1949.

Handford, R. H., and C. L. Neilson. Insects of the season 1949 in the interior of British Columbia. *In* The Canadian Insect Pest Review 28: 7-10. Canada Dept. Agr., Div. Ent. (processed). 1949.

Knight, H. H. A revision of the genus *Lygus* as it occurs in America north of Mexico, with biological data on species from New York. Cornell Univ. Agr. Expt. Sta. Bull. 391: 592-594. 1917.

Knight, H. H. The plant bugs, or Miridae, of Illinois. Illinois Nat. Hist. Surv. Bull. 22. 1941.

Matthewman, W. G. *In* The Canadian Insect Pest Review 19: 198. Canada Dept. Agr., Div. Ent. (processed). 1941.

Parshley, H. M. On some Hemiptera from Western Canada. Univ. Michigan, Occasional Paper Mus. Zool. No. 71. 1919.

Parshley H. M. A report on some Hemiptera from British Columbia. Proc. Ent. Soc. British Columbia (Syst. Ser.) 18: 13-24. 1919.

Strickland, E. H. An annotated list of the Hemiptera (S.L.) of Alberta. Can. Ent. 85: 193-214. 1953.

Wagner, E., and J. A. Slater. Concerning some Holarctic Miridae (Hemiptera, Heteroptera). Proc. Ent. Soc. Washington 54: 273-276. 1952.

Whitcomb, W. D. The biology and control of *Lygus campestris* L. on celery. Univ. Massachusetts Agr. Expt. Sta. Bull. 473: 1-15. 1953.

House Fly Maggots Infesting a Child's Bed

In October 1952, a public health inspector brought in from North Vancouver, some very small maggots which had been removed from the surface and from inside the fabric of a mattress of a child's bed.

The inspector said that a similar infestation had occurred earlier that season on an expensive mattress recently purchased with a new bed. The owners had contacted the store from which the bed had been purchased and they and the manager of the store and the health inspector, had shredded the mattress and found many maggots and puparia inside the stuffing. The store then replaced the mattress and shortly afterwards, more maggots were found in the new one. As usual in such cases, the people concerned considered they had done the right thing

by drenching the mattress, the bed and the room, with insecticide. However, the inspector saved six maggots to bring to me. Three of these died shortly afterwards, but three pupated and between November 14 and November 18, three flies emerged which I identified as *Musca domestica* Linn. the common house fly. The flies were scarcely half the size of normal house flies so I sent one to Mr. G. E. Shewell, Division of Entomology, Ottawa, who confirmed my identification.

The inspector said that the house where the infestation occurred was right on the sea shore, belonged to people of some substance, was extremely clean and well kept and that the housewife declared that the baby's bed was always covered with a rubber sheet under the normal bed clothes. Probably the rubber sheet leaked and the mattress became soaked with urine, and when it was hung out to dry, the flies laid eggs upon it; certainly a diet of urine was famine rations because the maggots were half starved and stunted and the flies were the smallest I have ever seen of this species.

Amongst a long list of substances on which or in which house fly maggots can develop Hewitt* records "substances contaminated or mixed with excremental products, such as bedding from piggeries and from rabbits and guinea pigs, paper and textile fabrics which have been contaminated, as cotton and woollen garments, sacking, rotten flock-beds, straw mattresses, cess pools, etc.", but he does not mention urine-soaked material specifically, *i.e.*, material contaminated with urine only. (There *is* a recent reference to house flies developing on urine alone but I cannot locate it at this time.—*G. J. Spencer, University of British Columbia.*

* Hewitt C. Gordon, 1910. The House Fly. Manchester University Press.

SOME UNUSUAL RECORDS OF BEETLES IN VANCOUVER

G. J. SPENCER

Department of Zoology, University of British Columbia.

Two blocks from my house in West Point Grey are several rhododendron bushes whose lower leaves have been ragged for years. On May 20, 1952, I examined them at night with a flashlight, swept the bushes thoroughly and recovered a few specimens of *Brachyrhinus singularis* L. the clay-coloured weevil which injures laurel hedges so extensively in Vancouver, but more specimens of a weevil identified for me as *Strophosoma melanogrammus* Forst, an insect slightly smaller than the clay-coloured weevil. In his Catalogue of the Coleoptera of North America Leng lists one species (16641) in this genus, *S. coryli* (Fab.); I do not know when Forst named this second species. Andison (Proc. B.C. Ent. Soc. 38, 1942) mentions that Kaven in Germany found *B. singularis* attacking rhododendron, but this instance of *S. melanogrammus* would seem to be a new record for this species on this host.

Another unusual record is of a small bettle *Barypeithes pellucidus* Boh., No. 16672 in Leng's Catalogue, the only species in this genus, listed as "introduced" from Old France and recorded from New England and New York. This beetle was sent in to me from Burnaby where it was found in tunnels of one of our native death watch beetles *Coelosthetus* which was burrowing freely in timbers of an old house, heavily attacked by dry rot. Chunks of wood were sent to me (25.V.1953) and I recovered the beetles from the tunnels. This was the second time that I have taken this beetle from tunnels of *Coelosthetus*; but the first time I mistook them for strawberry root weevils that had merely sheltered in the wood and, unfortunately I discarded them. The insects which are slightly smaller than the strawberry root weevil, have a shining black head with very dark brown thorax, dark brown elytra and tan-coloured legs and antennae. It may be that this beetle is a predator on some stage of *Coelosthetus*; its occurrence in the death watch tunnels seems to be hardly accidental.

A third rather unusual beetle record is of a small Nitidulid, *Meligethes nigrescens* Stephens, not mentioned in Leng's Catalogue. Specimens of this insect were brought to me in April, 1953, from a neighbouring golf course

where they alighted in such numbers on the surface of a pail of water that a groundsman was carrying, as to excite his astonishment and curiosity. On the 10th of May, 1953, I collected several scores of this same beetle from the shady side of an empty concrete swimming pool at Milner in the Fraser Valley. Moisture was condensing on the side of the pool and the beetles confined themselves to the wet areas; if one moved on to a dry patch, it soon came back to the wet surface. The sides of the pool were vertical and, from somewhere, hundreds of these insects arrived, but alighted only on the damp areas. I am deeply indebted to Hugh B. Leech for the preceding three identifications.

Finally, on March 4th, 1954, a couple brought me some beetles which, they said, were continually appearing in their bath tub; they wondered if they were of economic importance. The small beetles are *Cryptophagus bidentatus* Makl., recorded from Alaska, of which I have one specimen taken from the fur of a Shrew at Alta Lake; however, *bidentatus* has very small ommatidia in its eyes and these specimens have larger, rather projecting ommatidia; otherwise they are very similar. I promptly asked the people if they had any polypore fungi in the house and, as it turned out, he is a school teacher who collects fungi so these beetles must have come from one of his specimens.

In the bath tub was also a larger 5½ mm. beetle which keys out in Hinton's monograph to the genus *Megatoma*, family Dermestidae. Leng calls the genus *Perimegatoma*, but Hinton states that the genotype of *Perimegatoma* cannot be distinguished from the genotype of *Megatoma* so the latter name has priority. Of this genus I have only two species at the University: *P. cylindrica* Kirby which is a synonym of *P. falsa* Horn, and *P. vespulae* Milliron which is proving a pest of the first magnitude in the departments of Zoology and Botany at the University where it attacks insect material in our cabinets and the plants in the herbarium.

SOME RECORDS OF ECTOPARASITES FROM FLYING SQUIRRELS

G. J. SPENCER

Department of Zoology, University of British Columbia.

From a number of records on hand of ectoparasites from flying squirrels, I have selected only those instances in which I picked off the specimens myself by a uniform system of combing, brushing and laboriously examining under a low power microscope in order to obtain the greatest number of specimens without resorting to the Werneck-Hopkins method of dissolving the fur in hot caustic soda.

The same procedure is followed when examining birds and mammals, namely, parting the fur on the neck and head under a stereoscopic microscope to find an egg or a louse as an indication of infestation, and, if either is present, combing the head and neck first and then the whole body with a medium, then a fine-toothed comb and brushing in all directions over a large sheet of white paper with a stiff test-tube brush. Short-haired mammals or birds with short feathers on neck and head are subjected also to a rapidly rotating round brush twirled by a machine. Every animal is examined both as soon as received and again, after being held overnight in a refrigerator at 18° F. to either kill or stiffen any lice which would not release their hold under the first treatment.

The local flying squirrel *Glaucomys sabrinus oregonensis* (Bachman) is fairly common in the woods on the campus

Some records of Ectoparasites from Flying Squirrels

	VANCOUVER					Alta.
	A	B	C	D	E	F
	1 Nov. 1954 (per cat)	15 Nov. 1954 (per cat)	11 July 1955 Trapped	12 Aug. 1955 Trapped	12 Aug. 1955 Trapped	Alberta 1947
Sucking lice						
Microphthirus uncinatus (Ferris)	39	180	4		4	5
Neohaematopinus sciuropteri (Osborn)	13	127	19	16	28	3
Hoplopleura trispinosa Kell. & Ferris		70	6	3	7	8
Fleas						
Opisodasys vesperalis (Jordan)		16m. 21f.	4		2	
Monopsyllus ciliatus protinus Jordan		1				
Ticks						
Ixodes pacificus Cooley		1				
Mites						
Spp. undetermined		10 3spp.	13	1	6	

In the table above, specimens A and B were captured by the cat of President M. M. McKenzie which chewed off the head of specimen B before the squirrel could be taken from it. The finding on squirrel A of *Microphthirus uncinatus* (Ferris) constitutes, as far as I can find out from literature, the second record for this louse which Ferris named in 1919 as the genotype of a new monotypic genus. Ferris says "This is a very peculiar form, known only from North American flying squirrels of the genus *Glaucomys*. . . . known only from the original record from *Glaucomys sabrinus* at Yosemite National Park, California . . . This is one of the very smallest of all sucking lice, the male attaining a length of only about 0.35 mm. The insects are so small that as seen upon their host they are very likely to be mistaken for young of one of the other species which occur on these squirrels".

Specimen B would very probably have had a still higher parasite count if it could have been examined while the head was attached. As it is, the population present was the ultimate, almost the incredible, ever recorded from this host and certainly in record numbers. Apart from the huge populations of three species of lice, the numbers of the flea *Opidasys vesperalis* (Jordan) namely 16 males and 21 females, also seem to be a record and a considerable number may very well have ascaped in the course of the rough handling the squirrel got before it fell into my hands.

Specimen D was the only one of the six recorded here, to have no *M. uncinatus* on it and specimen E was unusual in that the hairs of the back half, above the hind legs, were plastered with louse eggs that had hatched but the young had not survived. This was an unusual location for louse eggs which are almost invariably attached on top of the head or around the neck. Of the three species of lice, *H. trispinosa* occurred all over the body but the other two species did not overlap; especially on specimen B *M. uncinatus* was entirely dorsal over the shoulder blades and *N. sciuropteri* entirely ventral across the sternum. All three

species of lice are specific to flying squirrels.

Specimen F from Alberta, is included here because it was sent in as a whole animal, not merely as a skin, and I was able to work it over myself. Its main interest is that it harboured Ferris' minute species *uncinatus* which seems widespread in more northern flying squirrels.

References

Ferris, G. F. Contributions Towards a Monograph of the Sucking Lice, Part I: 49; Figs. 31-32. 1919.

Ferris, G. F. The Sucking Lice, Memoirs Pacific Coast Ent. Soc., Vol I, p. 115; Figs. 50, 51. Cal. Acad. Sc., San Francisco 18, Cal. 1951.

LIST OF INSECTS AND MITES ATTACKING TREE FRUITS IN THE INTERIOR OF BRITISH COLUMBIA[1]

R. S. DOWNING[2], C. V. G. MORGAN[3], AND M. D. PROVERBS[3]

Entomology Laboratory, Summerland, B.C.

This is the first published list of insects and mites that attack tree fruits in the interior of British Columbia. It includes only the species that have caused economic loss. Although some of them are but sporadically injurious, none are merely occasional or incidental feeders. An E in the host columns designates the pest as one of major economic importance against which control measures must be frequently taken; an S indicates that it is only sporadically injurious.

1 Contribution No. 3352, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.
2. Assistant Entomologist.
3 Associate Entomologist.

Species	Apple	Apricot	Peach	Pear	Plum and Prune	Cherry
Acrididae, grasshoppers, various species		E	S	S	S	S
Anarsia lineatella Zell., peach twig borer		E	E		E	
Anisandrus pyri (Peck), pear blight beetle			S			S
Anthophila pariana (Clerck), apple and thorn skeletonizer	S					
Anuraphis bakeri (Cowen), clover aphid	S				S	
Anuraphis cardui (L.), thistle aphid		E			E	
Anuraphis persicae-niger (Smith), black peach aphid			E			
Anuraphis roseus Baker, rosy apple aphid	E					
Aphis pomi Deg., apple aphid	E			S		
Archips argyrospila (Wlkr.), fruit tree leaf roller	E	E		E	S	E
Archips cerasivorana (Fitch), ugly nest caterpillar						S
Archips rosaceana (Harr.), oblique-banded leaf roller	S	S	S	S	S	S
Aspidiotus ostreaeformis Curt., European fruit scale	E				E	S
Aspidiotus perniciosus Comst., San Jose scale	E	E		E	E	E
Bryobia praetiosa Koch, clover mite	E	S	S	S	E	S
Caliroa cerasi (L.), pear-slug				E	S	E
Carpocapsa pomonella (L.), codling moth	E	S	S	E	S	S
Cicadidae, cicadas, various species	S				E	S
Coleophora cerasivorella Pack. (= *C. occidentis* Zell.), cigar casebearer	S					
Coleophora pruniella Clem., cherry casebearer	E			S		E
Corythucha padi Drake, choke cherry tingid						S
Cyphoderris monstrosa Uhler, a cricket	S		S			
Datana ministra (Drury), yellow-necked caterpillar	E	S		S	S	S
Diptacus gigantorhynchus (Nal.), big-beaked plum mite			S		S	S
Edwardsiana rosae (L.), rose leafhopper	E				E	E
Empoasca maligna (Walsh), apple leafhopper	S					S

Species	Apple	Apricot	Peach	Pear	Plum and Prune	Cherry
Eotetranychus carpini borealis (Ewing), yellow spider mite	E					
Epitrimerus pyri (Nal.), pear rust mite	S					
Eriophyes pyri (Pgst.), pear leaf blister mite	E			E		
Eriosoma lanigerum (Hausm.), woolly apple aphid	E					
Erythroneura spp., leafhoppers						S
Estigmene acrea (Drury), salt-marsh caterpillar	S					
Forficula auricularia L., European earwig		S	S			S
Frankliniella occidentalis (Pergande), western thrip	E					
Grapholitha packardi (Zell.), cherry fruitworm						E
Grapholitha prunivora (Walsh), lesser appleworm	S					
Hyalopterus arundinis (F.), mealy plum aphid		E			E	
Hyphantria cunea (Drury) fall webworm	S		S			S
Incisalia iroides (Bdv.), western elfin	S					
Lecanium spp., scales	S	E	S		S	
Lepidosaphes ulmi (L.), oystershell scale	E	S	S	S	S	S
Limonius discoideus Lec., a click beetle					S	
Lygus spp., plant bugs	E		E	E		
Malacosoma disstria Hbn., forest tent caterpillar	E			S	S	S
Malacosoma pluviale (Dyar), western tent caterpillar	E			S		S
Marmara pomonella Busck, apple fruit miner	S					
Metatetranychus ulmi (Koch), European red mite	E	S	E	E	E	E
Mineola scitulella Hulst, Mineola moth	S					
Myzus cerasi (F.), black cherry aphid						E
Myzus persicae (Sulz.), green peach aphid		S	E		S	S
Oecanthus sp., a tree cricket	S					
Operophtera bruceata (Hulst), Bruce spanworm	S					
Phalaenidae, cut worms, various species	E	E	E	E	S	S
Phenacoccus aceris (Sign.), apple mealybug	E			S	S	S
Phorodon humuli (Schr.), hop aphid					S	
Phyllocoptes abaenus K., a rust mite					S	
Pristiphora californica (Marl.), California pear-slug				S		
Psylla pyricola Foerst., pear psylla				E		
Pulvinaria sp., a scale		S	E		S	
Rhagoletis fausta (O.S.), black cherry fruit fly						E
Rhopalosiphum prunifoliae (Fitch), apple grain aphid	E					
Sanninoidea exitiosa exitiosa (Say), peach tree borer		E	E		E	
Schizura concinna (A. & S.), red-humped caterpillar	S	S		S	S	S
Spilonota ocellana (D. & S.), eye-spotted bud moth	E	S	S	E	E	E
Stictocephala basalis (Walk.), a treehopper	E					
Stictocephala bubalus (F.), buffalo treehopper	E	E	E	E	E	S
Taeniothrips inconsequens (Uzel), pear thrips				E	S	S
Tetranychus mcdanieli McG., a spider mite	S					
Tetranychus pacificus McG., Pacific spider mite	S		S	S	S	S
Tetranychus telarius (L.), (=*bimaculatus* Harvey), two-spotted spider mite	E	S	E	S	E	E
Tetranychus urticae (Koch), a spider mite	S				S	
Torymus druparum Boh., apple seed chalcid	S					
Typhlocyba pomaria McA., white apple leafhopper	E				E	S
Vasates cornutus (Banks), peach silver mite			E			
Vasates (*Phyllocoptes*) *fockeui* (Nal. & Trt.), plum nursery mite					S	E
Vasates (*Phyllocoptes*) *schlechtendali* (Nal.), apple rust mite	E			S	E	
Xyleborus saxeseni (Ratz.), a shot-hole borer			S			

ANNOTATED LIST OF FOREST INSECTS OF BRITISH COLUMBIA PART III— *EUPITHECIA* SPP. (GEOMETRIDAE)[1]

D. A. ROSS[2] AND D. EVANS[3]

About 35 species of *Eupithecia* live on forest trees and shrubs in British Columbia. With the exception of *E. albicapitata* and *E. columbrata,* the local *Eupithecia* are defoliators: half the species of defoliators are conifer feeders; the others feed on broad-leaved trees. Several of the species are common although none has been observed to cause noticeable defoliation.

Eupithecia larvae are small slender loopers usually about 1 inch in length. The body is yellowish, brownish, or green; the majority of species have a dark dorsal line or stripe, occasionally subdorsal stripes. Others, *e.g.,* cedar and juniper feeders, have markings that resemble the foliage. Under high magnification, the larval skin appears to have a pebbly texture. The larvae of many British Columbia species are poorly known; only a few of the commonest ones are described in this paper.

All *Eupithecia* listed here overwinter in the pupal stage, excepting *E. bryanti, E. niphadophilata, E. unicolor,* and *E. graefii* which, presumably, hibernate in the larval or egg stage.

The species below are arranged in alphabetical order for convenience.

E. albicaptitata Pack. *Picea glauca* (cones and *Adelges* galls), *P. engelmanni* (cones); Interior B.C. and Whitehorse, Yukon Territory. **Larva:** Body flesh coloured, with reddish stripes.

E. annulata (Hlst.). *Pseudotsuga taxifolia, Picea engelmanni, P. glauca, Abies lasiocarpa, A. grandis, A. amabilis* (3 records), *Tsuga heterophylla, T. mertensiana* (1). Central Interior, Southern B.C. and V.I.†; a very common species. **Larva:** ¾ inch; head, pale brown; body reddish-brown or yellowish-brown; brown dorsal line, double on thorax; faint cream subdorsal stripe may be present; supraspiracular area reddish-brown; subspiracular fold cream; centre of suranal plate concolorous with head, edge cream-coloured.

E. arceuthata (Freyer). *Juniperus communis,* Fintry, Quesnel; *J. scopulorum,* Golden, Narcosli Creek. **Larva:** head and body, green; dark dorsal and supraspiracular stripes; spiracular line greenish-yellow.

E. bryanti Tayl. *Salix* sp., Saturna Island. Larva collected May 20, pupated May 22, adult emerged June 15.

E. castigata (Hbn.). *Alnus rubra* (1), Upper Pitt River, Pitt River, Buntzen Lake; *Populus balsamifera* (1), Mile 20, Alaska Highway. **Larva:** creamy-brown ground colour, dark brown markings on the dorsum.

E. columbiata columbiata (Dyar). *Salix* spp., Mabel Lake; *Alnus* spp., Trinity Valley, Lillooet River; *Betula* sp., Quesnel, Queens Bay; *Acer glabrum,* Creston. **Larva:** brownish-red, with dark lines on dorsum.

E. columbiata holbergata MacK. *Alnus* spp., *Salix* sp., *Rhamnus purshiana,* Southern Coast and V.I. **Larva:** reddish-brown body; vague lines on dorsum; broken dark subdorsal stripe; short anal tubercles.

E. columbrata McD. *Picea sitchensis* (cones); Southern Coast and V.I. **Larva:** pale orange-brown, shaded darker on the dorsum.

E. filmata Pears. *Picea engelmanni, P. glauca, P. mariana, P. sitchensis, Abies lasiocarpa* (1 record); Central and Southern Interior, and Northern Coast. **Larva:** head, pale brown; body pale brown with dark brown markings; brown pattern on dorsum extending to sides of body about each abdominal spiracle; broken dark brown subdorsal line; subspiracular stripe cream-coloured. This pattern may be obscure on some specimens.

E. fletcherata Tayl. *Alnus* sp., Dashwood V.I. **Larva:** pale brown, dark brown "diamond" pattern on dorsum.

E. gelidata Moeschler. Mile 1184, Alaska Highway, Y.T.

E. georgii McD. *Betula papyrifera* (1 record), *Ceanothus* sp. (1); Enderby, Falkland, Armstrong, Squilax. **Larva:** "pale brown; double dorsal line expanding into diamond pattern."

E. gibsonata Tayl. *Thuja plicata*; Minnette Bay, Terrace.

E. graefii vancouverata (Tayl.). *Arbutus menziesii, Thuja plicata* (1), *Pseudotsuga taxifolia* (1); V.I. Pupates in July, adult emerges August. **Larva:** variable yellow-green; reddish dorsal stripe onto vertex of head; reddish spiracular line sometimes present.

E. harrisonata MacK. *Tsuga heterophylla, Abies amabilis* (5), *A. grandis* (4), *A. lasiocarpa* (1), *Pseudotsuga taxifolia* (4), *Picea glauca* (3); Southern Coast and V.I. **Larva:** apparently there are two colour phases: one is a

1 Contribution No. 222, Forest Biology Division, Science Service, Department of Agriculture, Ottawa, Canada.

2 Forest Biology Laboratory, Vernon, B.C.

3 Forest Biology Laboratory, Victoria, B.C.

† Vancouver Island.

velvety green; the other is reddish-brown. Both phases have a dark dorsal line with pale edging; fine dark subdorsal lines, yellowish subspiracular lines; dark venter, usually with light subventral lines.

E. kananaskata MacK. *Alnus* sp. (1 record); Vedder; (Kaslo and Chilliwack - MacKay 1951). **Larva:** "dorsum has long diamond markings."

E. longipalpata Pack. *Tsuga heterophylla, T. mertensiana* (1), *Pseudotsuga taxifolia, Abies grandis* (3), *Picea sitchensis* (2), *Pinus monticola* (1), *Pinus contorta* (1), *Thuja plicata* (1); V.I., Queen Charlotte Islands, Southern and Central Coast. **Larva:** "head and body yellowish-green; dark dorsal line; pale subdorsal lines sometimes present; yellowish spiracular line."

E. luteata bifasciata (Dyar). *Pseudotsuga taxifolia, Picea engelmanni, P. sitchensis, P. mariana* (1), *Abies lasiocarpa, A. amabilis, A. grandis* (2), *Larix occidentalis, L. laricina, Tsuga heterophylla, Pinus contorta* (1), *P. monticola* (2); Central and Southern B.C. and V.I. This is one of the most abundant of the forest *Eupithecia*. **Larva:** ground colour variable — may be yellowish-green, brownish, orange or reddish; dark dorsal line, may be broken; light brown subdorsal lines; suranal plate usually tipped red; dark venter, with light subventral lines.

E. maestosa harlequinaria (Dyar). *Alnus* spp., *Arbutus menziesii* (3), *Prunus* **sp.** (1), *Salix* sp. (1), *Quercus garryana* (1); Southern Coast and V.I. **Larva:** head and body, pale green; reddish dorsal stripe.

E. maestosa maestosa (Hlst). *Alnus* sp., Athalmer. Larvae taken during July pupated in August. **Larva:** "greenish-yellow".

E. misturata misturata (Hlst). *Rhamnus purshiana, Malus* spp.; Southern Coast and V.I. **Larva:** body. pale green, darker at terminals; darker dorsal and subdorsal lines; yellowish spiracular line.

E. nimbicolor (Hlst). *Salix* sp.; Miles 878 and 1202, Alaska Highway. **Larva:** "a pale yellow or cream".

E. niphadophilata (Dyar). *Juniperus communis*, Southern Interior; larvae taken May 24 - June 13, pupated in June and July; adults emerged in August. **Larva:** head pale greenish with brown blotches; body, green, black dorsal stripe; cream coloured spiracular area; brownish patch on suranal plate.

E. olivacea Tayl. *Pseudotsuga taxifolia, Tsuga heterophylla, Abies amabilis* (3), *A. grandis* (2); Southern Coast. **Larva:** head, pale brown; body yellowish-brown with darker diagonal markings along dorsum.

E. ornata (Hlst). *Pinus contorta, P. monticola* (1 record); Southern B.C. and V.I. **Larva:** 1 inch long; head, tan; body, light or yellowish-green; fairly bright red dorsal stripe edged with yellow; anal prolegs and anal tubercles reddish.

E. palpata Pack. *Pinus contorta, P. monticola P. ponderosa*, (3 records); Central and Southern Interior. **Larva:** pale tan head; greenish-yellow body, dark dorsal line, may be partially obscured by reddish or orange dorsum; yellowish spiracular stripe.

E. perfusca (Hlst.). *Betula papyrifera*, Enderby, Mara, Creighton Valley, Howe Sound. **Larva:** small tan head; body greenish-yellow; suranal plate reddish.

E. perfusca kootenaiata (Dyar). *Salix* sp., *Alnus* sp.. *Betula* sp. (1 record); Northern B.C., and Tagish and Whitehorse, Y.T. McDunnough (1949), gives the following distribution: "Fairly general in the south central region of British Columbia". **Larva:** "body yellowish with dark long diamond pattern on dorsum."

E. placidata Tayl. *Thuja plicata, Juniperus scopulorum*; Southern B.C. north to Alexandria in the Interior. **Larva:** resembles cedar or juniper twig. Head, tan; body, green; black or brown dorsal line, in form of a small U on the prothorax, and a chain of diamonds on the dorsum of the abdomen; a rusty brown patch on A4 and A5.

E. pseudotsugata MacK. *Pseudotsuga taxifolia, Picea glauca* (1 record); Southern Interior. **Larva:** "head, tan; body greenish or yellowish; reddish-brown dorsum with dark dorsal line." Apparently larvae of this species have been confused in the past with *E. ornata* and *E. palpata.*

E. ravocostaliata Pack. *Salix* sp.; Central and Southern Interior and V.I. **Larva:** head and body bright green; olive-green dorsal and subdorsal lines; yellow subspiracular line, edged below with red; red anal tubercles.

E. rotundopuncta Pack. *Salix* sp., *Picea sitchensis* (host?), Prince Rupert; Queen Charlotte Islands. **Larva:** head, brown; body, pale brown; broken brown lines on dorsum.

E. satyrata (Hbn.). *Salix* sp., Mile 1084 Alaska Highway; Carcross, Y.T.

E. transcanadata MacK. *Pseudotsuga taxifolia, Picea engelmanni, Tsuga heterophylla, Abies lasiocarpa, A. grandis, Thuja plicata, Larix occidentalis, L. laricina*; Central and Southern Interior, and West Prince Rupert Forest District. **Larva:** body, greenish; dark reddish dorsal line; fine dark subdorsal lines; larva very similar to *E. palpata.*

E. unicolor (Hlst.). *Thuja plicata, Pseudotsuga taxifolia, Tsuga heterophylla* (3), *Abies* spp., V.I.. Southern Coast. Larvae taken May 4 to July 12; pupae collected in latter half of July; adults emerged in insectary from June 18 to August 11. **Larva:** a twig mimic somewhat similar to *E. placidata*; "head reddish excepting the top, which is pale."

E. usurpata Pears. *Abies amabilis, A. grandis, Tsuga heterophylla* (1). *Thuja plicata* (1); V.I. and Southern Coast. **Larva:** head, bright tan; variegated brown diagonal pattern on body; irregular yellow spiracular line; dorsal and subdorsal lines at terminals.

E. vinsullata MacK. *Pseudotsuga taxifolia* Southern Interior. **Larva:** "body, pale brown or yellowish; dark dorsal line, fine lateral line; light spiracular line."

Acknowledgments

Most of the adults in our collection were identified by Miss M. R. MacKay, Entomology Division, Ottawa. Our relatively advanced stage of knowledge of this group is due to the interest that Miss MacKay took in *Eupithecia* while she was stationed at the Vernon laboratory.

Descriptions of larvae appearing in quotation marks were made by laboratory personnel other than the authors.

References

MacKay, M. R. Species of *Eupithecia* reared in the Forest Insect Survey in British Columbia. Canad. Ent. 83:77-91. 1951.

McDunnough, J. H. Revision of the North American species of the genus *Eupithecia*. Bull. Amer. Mus. Nat. Hist. 93(8):537-728. 1949.

ANNOTATED LIST OF FOREST INSECTS OF BRITISH COLUMBIA
PART IV—*HYDRIOMENA* SPP. (GEOMETRIDAE)[1]

D. A. ROSS[2] AND D. EVANS[3]

These loopers are considered to be of no economic importance since they occur in small numbers and have not been known to cause any appreciable defoliation. Of the 11 species noted here, 7 are conifer feeders; the others feed on broad-leaved hosts. The larvae of most species of *Hydriomena* are brownish; some species are banded, at least in the early instars.

H. albimontanata, divisaria, irata, nubilofasciata, and *renunciata* overwinter in the pupal stage; some, if not all of the other species overwinter in the larval stage.

H. irata Swett. All of our typical *irata* specimens came from *Picea sitchensis* on the Queen Charlotte Islands. McDunnough designated other series of specimens as "probably all forms of *H. irata*". The latter were reared from *Tsuga heterophylla, T. mertensiana, Pseudotsuga taxifolia,* and *Picea* sp. in various parts of British Columbia south of 54° latitude. **Larva:** pale brown head and suranal plate; early instars banded with reddish-brown or drab green; later instars with dark broken subdorsal and spiracular lines.

H. marinata exasperata B. & McD. *Pseudotsuga taxifolia,* Qualicum; *Abies grandis,* Sooke; *Picea sitchensis,* Knight Inlet. Pupation occurs in June; adults emerge late in June or early July.

H. probably **edenata grandis** B. & McD. *Pseudotsuga taxifolia,* Colwood on Vancouver Island. Larva pupated April 29; adult emerged in May.

H. divisaria Wlk. *Picea engelmanni, Pseudotsuga taxifolia, Abies lasiocarpa*; Central and Southern Interior.

H. renunciata Wlk. *Alnus* spp. Most of the specimens from V.I. and the Southern Coast are designated as *H. r. columbiata.* Other specimens from this area and Central and Southern Interior B.C. are designated as *H. renunciata.* Probably this is the commonest of the forest *Hydriomena* in B.C. **Larva:** head and prothoracic shield, brown; body, with purplish bands; pale double dorsal, wide subdorsal, and spiracular lines.

H. albimontanata McD. *Pseudotsuga taxifolia,* Southern Interior. **Larva:** head, tan; body, light brown, with a small dark brown patch on dorsum of each segment; small brown patches on sides of thorax.

H. furcata Borg. *Salix* spp. V.I. and Coast, and Central Interior. Pupation as early as June 11; first adult emergence date is July 13. **Larva:** 1 inch; very dark brown head and body; light subdorsal and spiracular lines; indistinct pale supraspiracular line.

H. speciosata Pack. *Pinus contorta, Pseudotsuga taxifolia, Tsuga heterophylla*; V.I. One specimen from *Abies Grandis,* Valdes Island, one from *Pseudotsuga taxifolia,* Salt Spring Island, and one from *Tsuga heterophylla,* Bute Inlet were designated as *H. s.* form *taylori*

---

1 Contribution No. 223, Forest Biology Division, Science Service, Department of Agriculture, Ottawa, Canada.

2 Forest Biology Laboratory, Vernon, B.C.

3 Forest Biology Laboratory, Victoria, B.C .

Swett. **Larva:** head, dark brown; body, pale brown, brighter on sides; dark irregular dorsal and "lateral" lines.

H. morosata B. & McD. *Pinus contorta,* Commotion Creek (near Moberly Lake).

H. nubilofasciata Pack. *Quercus garryana*; Victoria. **Larva:** complex linear pattern of bright variegated brown and grey.

H. manzanita Tayl. *Arbutus menziesii,* V.I. and Southern Coast. **Larva:** head and body greenish-yellow; fine greyish lines on dorsum.

Reference

McDunnough, J. H. 1954. The species of the genus *Hydriomena* occurring in America north of Mexico. Bull. Amer. Mus. Nat. Hist. 103(3):241-358.

AN ANNOTATED LIST OF THE COLEOPTERA TAKEN AT OR NEAR TERRACE, BRITISH COLUMBIA. PART 3.*†

M. E. CLARK

Masset, Queen Charlotte Islands, B.C.

Melyridae

Dasytes sp.
Allonyx sp.
Eurelymis atra LeC.—Taken in 1931; vide H. C. Fall.

Cleridae

Thanasimus undatulus Say—Det. by Wolcott.
Thanasimus undatulus monticola Wolc. — Det. Wolcott.
Enoclerus sphegeus Fab.—Scarce on spruce logs in June; vide A. B. Wolcott.

Corynetidae

Necrobia violacea Linn.—Rare; found in marrow bones, June and July.

Cephaloidae

Cephaloon tenuicorne LeC.—Rare.

Oedemeridae

Calopus angustus LeC.—From a yellow pine stump, April 1921; rare.
Ditylus quadricollis LeC.—Rare; taken by the creek, June 4, 1920.

Mordellidae

Mordella borealis LeC.—Frequent, from a yellowish-brown fungus on spruce logs, July to September; vide Liljeblad.
Mordella marginata Melsh.
Anaspis rufa Say—Common on red osier dogwood **(Cornus),** and **Spiraea,** June and July.
Anaspis atrata Champ.—Verified by Liljeblad.

Laricia nigricolor Lilj.—A paratype from my material is in Mr. Frost's collection.

Elacatidae

Eurystethus californicus Mots.—Vide H. C. Fall.

Pythidae

Lecontia discicollis LeC.
Pytho seidlitzi Blair—November, 1927.
Priognathus monilicornis Rand.

Pyrochroidae

Ischalia vancouverensis Harr.—Rare; 1927.
Dendroides bicolor Newn.—Rare; on apple tree.
Dendroides sp.—"Probably **D. ephemeroides** Mann., but cannot verify it", wrote Mr. Frost.

Pedilidae

Eurygenius campanulatus LeC. — Det. by J. J. du Bois.

Anthicidae

Anthicus simiolus Csy.
Anthicus floralis Linn.

Elateridae

Lacon profusus Can.—Rare. [Now a synonym of **brevicornis** LeC.].
Lacon rorulentus LeC.—Scarce.
Athous cribratus LeC.
Athous rufiventris ferruginosus Esch.
Athous pallidipennis Mann.
Ludius kendalli Kby.
Ludius fraternus LeC.—Det. by Quirsfeld; frequent on flowers.
Ludius sp. near **fraternus** LeC.
Ludius volitans Esch.—Det. by Brown and Quirsfeld.
Ludius umbricola Esch.—Det. by Knull and Brown.
Ludius caracinus Germ.—Det. by Brown and Quirsfeld.
Ludius kaweana Fall—Det. by Fall (originally as **rufipennis** Fall), and Quirsfeld
Ludius sagitticollis Esch.—Det. by Fall.

---

* Parts 1 and 2 appeared in this journal in 1947 and 1948: 44:24-27; 45:21-24. As before, I am particularly indebted to Mr. C. A. Frost for identifications, or for help in obtaining them from specialists. I wish also to acknowledge the generous help received from all persons listed below; without it the list could not have been made.

† Editor's Note:—As with the two previous papers of this series, Mr. Hugh B. Leech, from whom the typescript was received, is responsible for the extensive editorial work and taxonomic checking so essential to a manuscript of this kind.—K.M.K.

Ludius resplendens Esch.—Det. by Brown.
Ludius cruciatus festivus LeC. — Det. by Brown.
Ludius suckleyi LeC.
Ludius aereipennis Kby. — Det. by Brown. The commonest wireworm pest; flies in May.
Ludius carbo Lec.?
Ludius rotundicollis Say—Brown says "a complex".
Ludius pudicus Br.—Det. by Brown.
Ludius propola columbianus Br. — Det. by Brown; considered to be the same as **nubilus** LeC. by Fall. Rare; taken in 1931
Ludius triundulatus Rand.—Scarce; on pine in July.
Ludius bombycinus Germ.—Det. by Brown.
Eanus maculipennis LeC.
Hemicrepidius morio LeC.
Hypnoidus nocturnus Esch.—May 1, 1921; det. Quirsfeld.
Hypnoidus nocturnus var. **lucidulus** Mann. —Det. by Knull.
Hypnoidus tumescens LeC. — June 2, 1920; det. by Knull.
Hypnoidus abbreviatus Say—Det. by Knull.
Hypnoidus striatulus LeC.—Under a stone, 1927; det. by Quirsfeld.
Hypnoidus ornatus LeC.—Det. by Quirsfeld.
Hypnoidus quadripustulatus Fab. — August, 1927, under a stone; det. by Quirsfeld.
Dalopius tristis Br.?—A female, probably of this species; det. by Brown.
Dalopius sp—An unknown species.
Sericus incongruus LeC. — A synonym of **brunneus** Linn., teste W. J. Brown.
Agriotes nevadensis LeC.—Det. by Quirsfeld; but det. as **A. ferrugineipennis** by Van Dyke.
Agriotes tardus Br.—Frost's note says "instead of **nevadensis**", and that these species are being studied by Becker.
Ampedus carbonicolor Esch. — Taken on Thornhill Mountain. Det. by Quirsfeld, Van Dyke and Knull
Ampedus sp., nearest to **nigrinus** Herbst — Fall's note: "Never saw a **nigrinus** from N. America".
Ampedus affinis LeC.—Vide H. C. Fall.
Ampedus behrensi Horn—Det. by Knull and Quirsfeld.
Ampedus varipilis Van Dyke—From rotten spruce. Det. by Knull.
Ampedus bimaculatus Van Dyke—Taken in 1935; det. by Knull and Fall.
Ampedus phelpsi Horn—Det. by Knull, Van Dyke and Fall.
Ampedus dimidiatus LeC.
Ampedus pullus Germ.—Det. by Brown.
Ampedus hoppingi Van Dyke—On Salix. Det. by Knull, but called a variety of **phelpsi** by Fall.
Ampedus moerens LeC.—Det. so by Fall, but called "**moerens** LeC.?" by Brown.
Megapenthes caprella caprella LeC.—Det. by Brown.
Cardiophorus fenestratus LeC. — Taken in 1932; det. by Knull.

Melasidae

Epiphanis cornutus Esch.
Microrhagus pectinatus LeC.

Throscidae

Pactopus horni LeC.—Det. by Fall.
Throscus carinicollis Schffr.—Det. by Fall.

Buprestidae

Dicerca tenebrosa Kby.—One taken in 1934.
Buprestis maculiventris var. **rusticorum** Kby. —in numbers on burnt spruce.
Buprestis adducta Csy.?—"Possibly syn. of **rusticorum**" was Frost's note.
Buprestis langi Mann.—Scarce; specimens show much variation in colour.
Melanophila acuminata Deg.
Melanophila fulvoguttata var. **drummondi** Kby.—On flowers.
Anthaxia aeneogaster Lap.—Scarce; taken on yellow avens, wild roses and **Crataegus**.
Anthaxia aeneogaster var. **foveicollis** LeC.—On wild rose.
Chrysobothris trinervia Kby. — Taken in 1933; vide Fall.
Agrilus anxius Gory—Found in 1931; the first **Agrilus** taken in this district in 10 years of collecting. Mr. Frost thinks it is probably the poplar species recently described as
Agrilus politus Say.

Tenerbrionidae

Phellopsis porcata LeC.—Under bark; June.
Eleates explanatus Csy.—June, 1921.
Scaphidema pictum Horn—Taken in 1927.
Platydema oregonense LeC.—Taken in 1931.
Tribolium ferrugineum Fab.—In flour, giving it a bad smell and taste; also in various meals.
Tribolium confusum Duv.—In a dried insect; also feeds on black pepper.
Iphthimus serratus Mann.—Rare.
Iphthimus opacus LeC.?—Common in rotten wood and about roots of trees.
Upis ceramboides Linn.—Scarce; on logs in June.
Boros unicolor Say—Scarce; on pine, April to September.

Melandryidae

Tetratoma concolor LeC.
Orchesia castanea Melsh. — Reared from fungus on birch, 1937. Det. by H. C. Fall, who said it was a new record for the West.
Prothalpia holmbergi Mann.
Melandrya striata Say.
Phryganophilus collaris LeC. — Taken on June 6, 1920; scarce, on flowers and leaves.
Xylita laevigata Hellw.
Zilora hispida LeC. — From under hemlock bark. Det. by Van Dyke and Mank.
Scotochroa basalis LeC.—Vide Miss Mank.
Stenotrachelus arctatus Say—Rare.

Ptinidae

Trigonogenius globulum Sol.—Found in pail of condition powder for cattle.
Ptinus fur Linn.—On books, December 31, 1924: vide Fall.

Ptinus tectus Boield.—Det. Fall. Another name is **ocellus** Br.

Anobiidae

Utobium elegans Horn — Rare, July; vide Fall.
Coelostethus americanus Fall.
Stagetus profunda LeC.—Very rare. Det. by Fall.

Ciidae

Cis impressa Csy.—In fungus on **Betula** sp.; scarce.
Cis serricollis Dury?
Cis criddlei Dury—Det. by Dury.
Cis hystricula Csy.—vide A. S. Nicolay and compared with the type.
Cis sp. near **hystricula** Csy.
Xestocis moznetti Dury—On a hard woody fungus, June and July, 1931. Vide Nicolay; but equals **ephippium** Mann., teste Fall.
Xestocis biarmata Mann.—Det. by Nicolay.
Octotemnus denudatus Csy. — From fungus on **Betula** sp.

Scarabaeidae

Aegialia rufescens Horn—Det. by Fall.
Aegialia lacustris LeC.—Under driftwood in river sand, August, 1927. Det. by Brown.
Aphodius omissus LeC.
Aphodius fimetarius Linn.—Common about stable-yard and pasture.
Aphodius sp. near **congregatus** Mann.—Det. by Cartwright. Common in the fall on fresh cow dung; also taken on Thornhill Mountain.
Aphodius tenellus Say—Det. by Brown.
Aphodius pectoralis LeC.—Det. by Fall.
Aphodius vittatus Say—Found on barn window, 1931, and under boxes of dung.
Phyllophaga anxia LeC—Common in fruit orchards at apple blossom time.
Polyphylla ruficollis Csy., var.—Scarce; the larvae were destructive to blackberry roots.
Dichelonyx backi Kby. — Taken by Fred Michaud on Thornhill Mountain, lying on snow banks. Subsequently found by me on thimbleberry bushes by the Skeena bridge, 1939.
Dichelonyx fulgida LeC.

Cerambycidae

Tragosoma harrisi LeC.—Rare; one dead under bark of **Tsuga** sp., September, 1920; afterwards took a few at lighted windows in July.
Spondylus upiformis Mann.—Flying in June, and on spruce logs.
Asemum atrum Esch.
Tetropium velutinum LeC.
Tetropium columbianum Csy.
Criocephalus agrestis Kby.
Stromatium sp.—Taken in 1938. Mr. Frost's note: "Probably undescribed."
Stenocorus lineatus Oliv. — Larvae under pine bark; adults feed on pine pollen in early spring.
Pachyta lamed Linn. — Found on **Aruncus sylvester** in July.
Pachyta armata LeC. — From Thornhill Mountain.
Evodinus vancouverensis Csy.—On flowers of **Aruncus sylvester** in July.
Pidonia scripta LeC.—Frequent on flowers of osier dogwood and thimbleberry in June.
Grammoptera filicornis Csy.—June, 1920.
Acmaeops pratensis Laich.—Scarce.
Acmaeops proteus Kby.—Rare.
Leptura obliterata Hald. — Frequent on "everlasting" flowers in August.
Leptura vitiosa LeC.—Typical form. Said by Hopping to be a synonym of **obliterata.**
Leptura propinqua Bland.
Anoplodera chrysocoma Kby.—Frequent on **Aruncus** and everlasting, July and August.
Anoplodera aspera LeC. — Typical form; scarce, on everlasting.
Anoplodera aspera var. **parkeri** Hippisley—Rare; taken in 1920; type in C. A. Frost's collection.
Anoplodera nigrella Say—Very rare; from Thornhill Mountain.
Anoplodera nigrella var. **praestans** Csy.—Rare.
Anoplodera sanguinea LeC.—Scarce, on everlasting; on poplar in July.
Anoplodera canadensis cribripennis LeC. — Typical, all red as in type; scarce, on logs in August.
Anoplodera canadensis var. **ebena** Leng — "Nearly typical"; scarce, on flowers of everlasting.
Anoplodera sexmaculata Linn. — Frequent, on **Aruncus.**
Anoplodera tibialis LeC.
Anoplodera crassipes LeC.—Rare; on everlasting.
Anoplodera valida LeC.
Desmocerus piperi Webb—Breeds in the pith of the western red-berried elder, **Sambucus.**
Leptalia macilenta Mann.
Semanotus litigiosus Csy.
Semanotus ligneus var. **basalis** Csy.
Semanotus ligneus var. **terracensis** Csy. — Described by Casey from specimens collected by me when I was Mrs. Hippisley.
Semanotus ligneus var. **amplus** Csy.—The larvae occur under the bark of cedar.
Phymatodes sp. near **decussatus** LeC.—Rare.
Xylotrechus undulatus Say—Frequent.
Xylotrechus undulatus var. **columbianus** Csy.?
Xylotrechus annosus Say—Frequent on cottonwood logs, and bred from galls on young poplar branches.
Neoclytus muricatulus Kby.
Plectrura spinicauda Mann. — First caught feeding on ripe wild raspberries; later reared from the stems of Devil's club (**Fatsia** sp.). My attention had been called to holes in the stems; finding a thicket apparently infested I cut stems and put them into a flat pan in a muslin bag, which was kept in a cool room. The beetles emerged in due course and when I examined the cage were running about actively. They appeared smaller than those picked from raspberries; Mr. Frost said they might me immature but I do not see how they could be.

The egg seems to be laid at the base of a leaf or branch bud or young growth in the just-burst stage. The young larva must first feed on this because the bud never does develop, but wilts and droops. Where one finds this the grub is always below in the main stem, as it seems to feed downwards in the pith.

Monochamus scutellatus Say, western variety.
Monochamus maculosus Hald.
Acanthocinus obliquus LeC.
Saperda populnea Linn.—Reared from round galls on young white poplar.
Saperda populnea var. **moesta** LeC. — On cottonwood logs.
Saperda calcarata Say.
Oberea quadricallosa LeC.

Chrysomelidae

Donacia hirticollis Kby.
Donacia emarginata Kby.—Mr. Frost said "Probably the var. **pacifica** Schffr."
Orsodacne atra Ahrens — On gooseberry leaves and flowers. Also the vars. **childreni** Kby. and **trivittata** Lac.
Syneta carinata Mann. — From Thornhill Mountain.
Syneta hamata Horn—Frequent on thimbleberry, **Rubus parviflorus**, in May and June.
Syneta simplex LeC.—On wild bitter cherry in May.
Zeugophora atra Fall—Scarce, July.
Pachybrachys sp.—Fall said: "near **lustrans** LeC. and **californica** Fall; does not fit either very well."
Pachybrachys peccans Suffr.—A dark form taken in fermenting grass, July 1936; vide H. C. Fall.
Diachus catarius Suffr.—Rare.
Adoxus obscurus Linn.—Scarce, but found all season.
Adoxus villosulus Schrank — Common all season.
Phaedon oviformis LeC. — Found in all stages of development on a small species of **Veronica**, locally known as false forget-me-not, that grows in muddy places or in field ditches. The plants, about six inches high, are covered with beetles and larvae in all stages during June and July; they completely destroy the plants, then suddenly disappear.
Phaedon armoraciae Linn.—Det. by Fall; also called **americanus** Schffr.
Chrysomela interrupta Fab. — On alder; sometimes common enough in June to be a pest. Vide Schaeffer.
Chrysomela aeneicollis Schffr.—Scarce.
Phyllodecta americana Schffr.—On willow in July; scarce.
Galerucella punctipennis Mann. — May 22, 1928. Scarce on willow, birch and poplar.
Galerucella carbo LeC.—Common on willow; sometimes a bad pest; June.
Galerucella nymphaeae Linn.—On lily pads, Lakelse Lake. June 8, 1923.
Altica bimarginata Say — Frost's note: "Probably **plicipennis** Mann. or var. **ambiens** LeC."
Altica tombacina Mann.—Vide Gentner.
Altica sp., nearest **aenola** Blatch; vide Fall.
Chalcoides helxines Linn.—Common on willow, May and June.
Crepidodera robusta LeC.—Vide Fall.
Hippuriphila equiseti Hatch and Beller—Ex rotten leaves, March 19, 1937. Det. Gentner; probably the same as **mancula** LeC.
Longitarsus erro Horn—From rotten leaves, March 19, 1937; det. Gentner.
Phyllotreta albionica LeC.
Phylotretta decipiens var. **ordinata** Chitt. — Det. by Gentner.
Psylliodes punctulata Melsh.

Platystomidae

Eurymycter fasciatus Oliv.—Taken in 1933.

Curculionidae

Rhinomacer elongatus LeC.—On pine shoots, Jack Pine Flats. Vide H. C. Fall.
Apion centrale Fall—Seen by H. C. Fall.
Dyslobus decoratus LeC.—Taken in 1931; det. C. Dury.
Panscopus sp.—"May be **pallidus**" wrote Mr. Frost.
Brachyrhinus ovatus Linn.
Sciopithes obscurus Horn—Det. Fall.
Geoderces incomptus Horn?
Sitona tibialis Herbst.
Trichalophus constrictus LeC.
Phytonomus nigrirostris Fab. — Common under bits of board in the spring, 1928.
Phytonomus trivittatus Say.
Lepyrus oregonus Csy.—Taken in 1933; det. Fall.
Listronotus sp., near **squamiger** Say.
Pissodes fasciatus LeC.?
Pissodes sp., near **affinis** Rand., "but not that species" (Frost).
Paraplinthus carinatus Boh.
Paraplinthus scrobiculatus Mann.
Hypomolyx piceus Deg.—On pine.
Dorytomus sp.
Notaris puncticollis LeC.
Trachodes quadrituberculatus Mann. — Det. Fall.
Aparapion horridus Mann.—Det. Fall.
Proctorus decipiens LeC.
Tychius picirostris Fab.—Taken in March, 1937, on lichens and rotten hemlock.
Magdalis aenescens LeC. — About gardens and wild fruit.
Magdalis hispoides LeC.
Anthonomus sp.—"Near **simiolus** Blatchley."
Orchestes parvicollis LeC.
Orchestes sp., near **pallicornis** Say. Det. Fall.
Auleutes cruralis LeC., or near.—Taken in fermenting grass, August, 1936.
Auleutes epilobii Payk.—Mr. Frost says this is European, and suggests that it and the preceding species are the same. However, I often took the latter. and always in the tops of fireweed (**Epilobium**) when the plants were about half grown; the plants were always distorted.
Ceutorhynchus decipiens LeC.—May, 1933; det. Fall.
Carphonotus testaceus Csy. — Vide L. L. Buchanan.

Cossonus subareatus Boh.
Cossonus quadricollis Van Dyke.
Cossonus sp., underscribed?
Rhyncolus brunneus Mann.—In rotten wood; vide Buchanan.
Rhyncolus spretus Csy.—Vide Buchanan.
Rhyncolus macrops Buch.—Two paratypes.

Scolytidae

Scolytus tsugae Sw.
Crypturgus borealis Sw.—April, 1937; bred from spruce bark; vide Fall and Knull.
Dolurgus pumilus Mann.
Polygraphus rufipennis Kby.—April 6, 1921; on spruce.
Dendroctonus murrayanae Hopk. — From spruce; vide Blackman.
Dendroctonus pseudotsugae Hopk.
Dendroctonus valens LeC.
Phloeosinus punctatus LeC. — March, 1942, on dead cedar branches; det. Blackman.
Alniphagus aspericollis LeC. — May 5, 1920; frequent on western alder; vide Blackman.
Hylurgops rugipennis Mann.—Det. Knull.
Hylurgops lecontei Sw.
Hylastes nigrinus Mann.
Trypodendron retusum Lec.—Det. Knull.
Trypodendron rufitarsis Kby.—November 4, 1923, and March, 1933. Vide Knull and Blackman.
Trypodendron cavifrons Mann. — August, 1927, and March 21, 1937. Det. by Blackman.
Gnathotrichus alni Blackm.—Det. by Knull.
Pityophthorus pseudotsugae Sw. — Det. by Knull.
Pityophthorus confertus Sw. — From green pine twigs, in May. Teste Blackman.
Pityophthorus sp.—An unknown species.
Ips tridens Mann.—Det. by Blackman.
Ips yohoensis Sw.? — From spruce. Vide Blackman.
Ips concinnus Mann.
Ips sp.—A species unknown to Knull.
Ips sp.—A species unknown to Blackman.
Orthotomicus vicinus LeC.—Found on pine, February 11, 1938. Det. by R. Hopping.
Dryocoetes septentrionis Mann.—March 21, 1937. Det. by R. Hopping.
Dryocoetes affaber Mann.—Vide Knull.
Dryocoetes betulae Hopk.—Det. by Blackman.
Dryocoetes pseudotsugae Sw. — March 21, 1937; vide Swaine.

REVISED CONSTITUTION OF THE ENTOMOLOGICAL SOCIETY OF BRITISH COLUMBIA

ADOPTED APRIL 28th, 1955

Article 1

Title

This Society shall be known as the Entomological Society of British Columbia, in affiliation with the Entomological Society of Canada.

Article 2

Object

The object of the Society shall be to foster the advancement, exchange and dissemination of entomological information.

Article 3

Membership, Dues and Expenditures

a) Any person interested in entomology may become a member on application to the Secretary of the Society and on payment of the annual dues.

b) A member may withdraw from the Society upon giving notice in writing to the Secretary.

c) An annual fee necessary for the operation of the Society shall be levied from each member as provided for in Section 1 of the By-Laws.

d) The executive shall have power to meet expenses required in the normal operation of the Society business. Such expenditures shall be subject to subsequent ratification at the Annual meeting by the majority of the members present.

e) A member who neglects to pay the annual fee for two consecutive years shall automatically cease to be a member.

Article 4

Meetings

a) The Annual meeting of the Society shall be called each year by the President at a time and place suitable to the majority of the members.

b) Other meetings of the Society may be held at any time or any place with the approval of the Executive and upon notification to the members.

c) Seven members in good standing shall constitute a quorum at the Annual meeting.

d) The meetings shall be informal insofar as possible.

Article 5

Officers

The officers of the Society shall consist of President, President-Elect, Vice-President, Secretary-Treasurer, Editor, Immediate Past President and three Directors These officers shall constitute the Executive with full power to act on behalf of the Society within the bounds of the constitution and to appoint committees as necessary.

Article 6

Elections

Elections shall be held once a year at the Annual meeting, and officers so elected shall remain in office until the next Annual meeting. The office of President shall not be held by the same member for more than two consecutive years. Normally, the President-Elect shall take office as President one year after his election as President-Elect.

Article 7

Duties of Officers

a) The President or designated alternate shall preside at all meetings and act ex-officio on all committees. He shall have primary responsibility for the program and arrangements of the Annual meeting.

b) The Secretary-Treasurer shall maintain a record of all meetings and act as the custodian of all minute books and correspondence. He shall also receive and disburse all funds, prepare the annual financial statement, and file a copy of the same with the Registrar of Companies as required under the "Societies Act".

c) The Editor shall act as editor of the "Proceedings" and other publications of the Society.

Article 8

Alteration of the Constitution

The Constitution may be altered or amended at any Annual meeting of the Society with the approving vote of three-quarters of the members present and in good standing. Such alterations must be made by notice of motion, which shall have been sent to the Secretary and a copy of such forwarded to all members at least two weeks before the Annual Meeting.

Proposed By-Laws

1. a) The annual fee for full membership shall be $2.00.
   b) A student membership fee shall be set at one-half the full membership fee, such a member having the privileges of a full membership.
   c) Honorary life members may be conferred at any Annual meeting of the Society by approval of a majority of the members present and in good standing. Honorary life members shall have all privileges of full members, without payment of dues.
   d) The fiscal year of the Society shall coincide with the calendar year, fees are payable in advance, at the time of the Annual meeting.
2. The President of the Society shall be the representative on the Board of Directors of the Entomological Society of Canada. The President is at liberty to appoint a substitute to represent him at the Annual Meeting of the National Society in the event that he is not able to attend.
3. a) The annual financial statement shall be presented by the Secretary-Treasurer at the Annual meeting.
   b) An auditor shall be appointed at each Annual meeting to audit the accounts of the Society.
4. The By-Laws may be changed at any Annual meeting by a motion approved by the majority of the members present and in good standing.

SCIENCE NOTES

Coleophora pruniella Clemens, a Casebearer New to the Okanagan Valley (Lepidoptera: Coleophoridae)

When Mr. Alex Watt, Horticultural Branch, British Columbia Department of Agriculture, West Summerland, was visiting an orchardist at Trout Creek Point, Summerland, in 1954, he noticed a number of cherry leaves showing an unusual type of injury, presumably caused by an insect. On visiting the orchard, I found that the cause of the trouble was a casebearer, subsequently identified by Dr. T. N. Freeman, Entomology Division, Ottawa, as the cherry casebearer, *Coleophora pruniella* Clem. This is the first known record of this species for the Okanagan Valley of British Columbia. The first and only other recorded occurrence of *C. pruniella* for the Province was at Creston in 1947 (Waddell, 1952).*

Several hundred mature casebearer larvae were collected on June 18 and kept in an insectary. Moths and parasites began emerging two weeks later; parasitism was approximately 0.75 per cent. Dr. W. R. M. Mason, Entomology Division, Ottawa, identified the parasites as *Bracon gelechiae* Ashm. and *Agathis* sp. near *conspicuus* (Wesm.). These species were not reported by Waddell (1952) among 23 species of Hymenoptera listed as parasitic on larvae and pupae of the cherry casebearer.

—*M. D. Proverbs, Associate Entomologist, Entomology Laboratory, Summerland, B.C. Contribution No. 3332, Entomology Division, Science Service, Department of Agriculture, Ottawa, Canada.*

* Waddell, D. B. Biology and control of the cherry casebearer, *Coleophora pruniella* Clemens, in British Columbia. Proc. Ent. Soc. British Columbia 48:85-89. 1952.

Another Record of Urinary Myiasis by Fannia Canicularis (L)

(Diptera: *Anthomyia,* in part).—On August 6 1953, a first year medical student of the University of British Columbia, working protem. as an orderly in New Westminster Hospital, sent in a letter of enquiry, with two maggots. In part, he said " . . . these insects were found in large numbers in a urine specimen of a five year old girl. They were found in repeated voidings but in diminishing numbers. The doctor brought in another (urine) specimen several days later but none could be found in it nor in a stool specimen . . . The doctor described the child as being very wild and uncooperative but she quieted down after treatment with terramycin".

The maggots were those of the anthomyid fly *Fannia* (*Homalomyia*) *canicularis* (L), the lesser housefly, whose larvae usually develop in human faeces and decaying vegetation, where the eggs hatch in about twenty-four hours and the larval growth is completed in six to twelve days and the pupal period occupies about nine days.

There are numerous records of the larvae of this species causing gastric and intestinal myiasis of man. The infestation generally occurs by somebody swallowing the eggs of the fly which are laid on a variety of household foods exposed to the air, and it is one of the few insects that can develop in the digestive tract. The presence of the maggots is usually indicated by nausea, vertigo and violent pains; the larvae in many cases are expelled by vomiting. If they occur in the intestine they are expelled with the faeces and their presence is indicated by diarrhoeal symptoms, abdominal pains or haemorrhage caused by the traumatic lesions of the mucous membrance of the intestine which the larvae affect (partly, after Matheson).

In addition, this species has been recorded from the human urethra of both males and females. Detwiler* (1929) reported a case of urinary myiasis caused by the larvae of this insect. The infestation in the urinary tract probably occurs by flies depositing their eggs about the anus or the external genital orifice and the tiny larvae hatching from the eggs, work their way up into the vagina and sometimes into the urethra, whence they normally are expelled after they have completed their development. Since these flies are common in warm weather the deposition of eggs may take place when a person is lying asleep on top of a bed in a naked or partly clothed condition. Usually no treatment is necessary because the larvae are expelled anyway.

It is surprising that such an infestation should occur in so young a child but if the home was unclean and the girl had not been frequently bathed, the infestation may have occurred when she was lying exposed on top of a bed.— *G. J. Spencer, University of British Columbia.*

* Detwiler, J. D. Notes on myiasis of the urinary passage caused by larvae of Fannia. 59th Ann. Rept. Ent. Soc. Ontario, 1928.57-59. 1929.

Collecting *Tabanus* Males

I have collected Tabanids for quite a number of years, but have never had the luck to find many males. This year, however, I found out that our early species *T. procyon* O.S. seems to congregate on rocks (large outcroppings of bedrock) as soon as they emerge. I took 41 males and 39 females on outcroppings of bedrock (about ¼ an acre in extent) in 6 days. I was surprised that the emergence lasted that long.

It wasn't very warm—62° high the first day; several days were warmer afterwards. First of all I thought they went on the rocks to copulate (probably the real reason), but I caught only one pair in copulation. It might be that the rocks were a little warmer. There are two small springs in the near vicinity, one on each side of the rocks. I am wondering if some of our other B.C. Tabanids have the same habit.

There were cows quite near but apparently the flies didn't bother them. None of the females flew round or settled on me, so possibly they don't try for blood until after they are fertilized. Perhaps someone else can answer that.—*H. R. Foxlee, Robson, B.C.*

Tropical Rat Mites in a Domestic Sparrow's Nest

The latter part of July 1955 I received a telephone call from the local R.C.A.F. depot at Sea Island regarding a plague of mites in a hangar, and requested that specimens be sent in for identification. The messenger left some specimens in a bottle somewhere outside our building where they were found six weeks later and handed to me. I cleared and mounted them and found that the mites were *Bdellonyssus bacoti* (Hirst), the tropical rat mite which the Station Medical Officer told me were found to have originated in a sparrow's nest.

A bird's nest is an unusual place for rat mites so it is likely that an infested nest was abandoned by the rats and the fabric used by the sparrows: upon the removal of the nest, the mites soon disappeared.
—*G. J. Spencer*, University of British Columbia.*

* Spencer, G. J. The menace of rat parasites in Vancouver in 1936. Proc. B.C. Ent. Soc. 33: 44, 45. 1937.

Control of the Cabbage Maggot, *Hylemya Brassicae* (Bouché), in Rutabagas - 1954*

In evaluating the treatments the categories of injury were as follows:

Clean—no maggot marks visible
Light—superficial maggot injury
Moderate—marketable for second grade after trimming
Severe—unmarketable

Exp. No. 54-17. Furrow, Band and Spray Methods. Five replicates in randomized blocks. Planting date, July 15. Band treatments applied July 12. Furrow treatment applied July 15. Second spray treatment applied August 31. The rutabagas were harvested October 29, appraisal being based on 40 roots per plot, 200 per treatment.

Insecticide	Method of Application	Amount Actual/acre (pounds)	Total Infestation Index	Total Damage Index	Damage Reduction (per cent)
Check			794	794	—
Heptachlor dust 2.5	Band	5.08	125	16	97.8
Heptachlor dust 2.5	Furrow	2.54	141	38	95.2
Aldrin dust 2.5	Band	5.08	154	38	95.2
Aldrin dust 2.5	Furrow	2.54	134	46	94.2
Aldrin emulsion	Surface	4.15	168	46	94.2
Heptachlor emulsion	Surface	2.18	149	50	93.7
Isodrin dust 2.0	Furrow	2.54	337	234	70.5

An infestation index was determined by placing penalties on infested plants as follows: Clean—0; light—1; moderate—2; severe—4; for the damage index only the two latter categories were used. Maximum damage index total 800.

The results confirm earlier findings of co-operative work carried out in British Columbia and Western Washington that effective control of root maggots attacking rutabagas is possible with heptachlor and aldrin under a wide range of conditions provided these chemicals are present in adequate amounts throughout the time protection from infestation is needed.

Angus J. Howitt,
Assistant Entomologist,
Western Washington Experiment Station,
Puyallup, Wash.

* The methods of application and evaluation are those described in detail and discussed by King, K. M. and A. R. Forbes, Jour. Econ. Ent. 47(4): 607-615, 1954. The work supplements that of King, K. M., A. R. Forbes, D. G. Finlayson, H. G. Fulton, and A. J. Howitt, Jour. Econ. Ent. 48(4):470-473, 1955; and Forbes, A. R. and K. M King, Jour. Econ. Ent. (in press).

IN MEMORIAM

James Rushton John Llewellyn-Jones, 1894-1954

James R. J. Llewellyn-Jones, an only child, was born in Newcote West Avenue, Exeter, England, on 27th July, 1894. His father died in 1902 and during the First World War when James was in one of the branches of the armed services, his mother (nee Rushton) passed away; early in 1951 his aunt, sister of his mother, also died leaving James the last remaining member of both sides of his family.

I have not been able to get any information about his life in England beyond the fact that he was M.A. in Theology from Cambridge University, probably completing his work there after the war and was later attached to Exeter Cathedral for a short time. He was elected a Member of the Royal Entomological Society of London in 1925.

He came out to Canada in 1930 and in 1931 settled at Arranmore, Cobble Hill, in a large house and some twelve acres of beautiful grounds. Beyond telling us that he was the owner of the smallest registered yacht in the British Empire he very rarely said anything about himself and seemed to spend his time collecting and rearing Macro-Lepidoptera. Shortly after coming out, he joined the Entomological Society of British Columbia of which he was an enthusiastic member, never missing an annual meeting and, over the years, publishing nine papers in our Proceedings, on the "Food plants of British Columbia Lepidoptera". He was President of our Society from 1943 to 1947 inclusive and showed more presidential enthusiasm than any other occupant of the position in thirty years.

In his Presidential addresses he advocated and strove to accomplish three objects (1) the increase of entomological literature in the Province, (2) the establishment of scholarships in aid of deserving students in Entomology and (3) a reserve fund for publishing our Proceedings. Towards the first two items, he generously willed his entomological library to the University and for some seven years awarded the entomological scholarship which bore his name, to the University. To establish a reserve fund for publishing our Proceedings, he, as a single man without any relatives and being possessed of considerable private means, willed his estate upon his death, to the Society. Being a very modest and quiet man, he was insistent that this matter should not be made known to the members of the Society but now that he has passed on, it can be mentioned as an indication of his general interest in Entomology and his wish to help our Proceedings. Unfortunately, the second world war so depleted his investments which were still in England, that in 1951 he was forced to cancel this disposition of his estate. At this period also, he was forced to put up his house and grounds for sale and early in 1954, he moved to a hotel in Vancouver, sending his large cabinet of some five thousand specimens of Macro-Lepidoptera to the University for sanctuary. Since he had published "An Annotated Check List of the Macro-Lepidoptera of British Columbia" as Occasional Paper No. 1 of the Entomological Society of British Columbia in June 1951, at his own expense, his collection of perfectly mounted, labelled and catalogued specimens makes, with this annotated check list, a major controbution to our science and to the University of this Province.

After moving to Vancouver Mr. Jones used to come out to the University every Wednesday morning for a couple of hours to work over his collection, insert new material and generally keep it up to date; this, in spite of the fact that for a couple of years he had been in extremely poor health. By the autumn of 1954 his health had improved very considerably and the doctors' reports were very encouraging. On the 24th of November he came out to the University as usual, was very cheerful, looked quite fit and said that he was feeling very much better. Some time during the night of 25/26 November, he passed away in his sleep and was buried on December 4th from St. James Anglican Church. Six members of the Society acted as pallbearers and a considerable number of friends attended the service and followed to Ocean View Cemetery where our friend and colleague lies buried.

(My thanks are extended to Mrs. Janet Patterson, of Steveston, to Mr. A. D. Crease, solicitor of Victoria and to Mr. R. J. P. Barriscale of Vancouver for information concerning the early life of Mr. Llewellyn-Jones.)

—G. J. Spencer.